

# **Module Manual**

Bachelor of Science

# General Engineering Science (English program)

Cohort: Winter Term 2015

Updated: 28th June 2017

# **Table of Contents**

Table of Contents	2
Program description	5
Core qualification	6
Module M0701: Chemistry (GES)	6
Module M0736: Linear Algebra	8
Module M0745: Electrical Engineering I	10
Module M1081: Mechanics I (GES)	12
Module M1139: Physics for Engineers (GES)	14
Module M0577: Nontechnical Complementary Courses for Bachelors	16
Module M0671: Technical Thermodynamics I Module M0737: Mathematical Analysis	1 <u>8</u> 20
Module M0737. Mathematical Arialysis  Module M0772: Electrical Engineering II	22
Module M1103: Mechanics II (GES)	<u>22</u> 24
Module M1121: Programming in C	26
Module M0594: Fundamentals of Mechanical Engineering Design	28
Module M0688: Technical Thermodynamics II	30
Module M1105: Mechanics III (GES)	32
Module M0730: Computer Engineering	34
Module M0853: Mathematics III	37
Module M0833: Introduction to Control Systems	40
Specialization Civil- and Enviromental Engeneering	43
Module M0740: Structural Analysis I	43
Module M0613: Reinforced Concrete I	45
Module M0672: Signals and Systems	47
Module M0706: Geotechnics I	49
Module M0744: Structural Analysis II	51
Module M0829: Foundations of Management	53
Module M0580: Principles of Building Materials and Building Physics	56
Module M0611: Steel Structures I  Module M0631: Concrete Structures II	58 60
Module M0755: Geotechnics II	62
Module M0733: Geolecimics ii  Module M0728: Hydraulic Engineering I	64
Module M0869: Hydraulic Engineering II	66
Module M0686: Sanitary Engineering	68
Specialization Energy and Environmental Engineering	71
Module M0598: Mechanical Engineering: Design	71
Module M0957: Introduction into Energy and Environmental Engineering	74
Module M0536: Fundamentals of Fluid Mechanics	76
Module M0610: Electrical Machines	78
Module M0618: Renewables and Energy Systems	80
Module M0829: Foundations of Management	82
Module M0956: Measurement Technology for Mechanical and Process Engineers	85
Module M1275: Environmental Technology	88
Module M0538: Heat and Mass Transfer	90
Module M0546: Thermal Separation Processes	92
Module M0639: Gas and Steam Power Plants	97
Module M0933: Fundamentals of Materials Science	100
Module M0670: Particle Technology and Solids Process Engineering	102
Module M1274: Environmental Technology	104
Specialization Biomedical Engineering	106
Module M0933: Fundamentals of Materials Science	106
Module M0634: Introduction into Medical Technology and Systems	108
Module M0672: Signals and Systems	110
Module M0680: Fluid Dynamics	112
Module M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	114
Module M1277: MED I: Introduction to Anatomy  Module M1278: MED I: Introduction to Radiology and Radiation Therapy	11 <u>6</u> 118
Module MOCOA: Heat Transfer	120
Module M0598: Mechanical Engineering: Design	122
Module M0398: Meditarical Engineering, Design  Module M0956: Measurement Technology for Mechanical and Process Engineers	125
Module M0662: Numerical Mathematics I	128
Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	130
Module M1333: BIO I: Implants and Fracture Healing	131
Module M0829: Foundations of Management	133
Module M1280: MED II: Introduction to Physiology	136
Module M1332: BIO I: Experimental Methods in Biomechanics	137
Specialization Naval Architecture	138
Module M0933: Fundamentals of Materials Science	138
Module M0829: Foundations of Management	140
Module M0854: Mathematics IV	143

			146
			148
			150
			153 155
			158
			160
			161
			164
			66
			166
Module	M0937:	Physical Chemistry	168
Module	M0536:	Fundamentals of Fluid Mechanics	170
			172
			175
			178
		<del>-</del>	180
			183 185
			187
			192
			196
			198
Module	M0670:	Particle Technology and Solids Process Engineering	201
Special	ization	Electrical Engineering 2	203
			203
			205
			208
			212
			214
			216
			217 220
			222
			224
			227
Module	M0777:	Semiconductor Circuit Design	229
			232
Special	ization	Computer Science 2	235
			235
			236
			238
			240
			242 245
		O-min-ray O-manutay Original and Mathematica	245
			249
			251
Module	M0731:		253
Module	M0791:		255
		'Y'	257
			258
			260
			260
			263
			265 267
		Signals and Systems	269
		Fluid Dunamina	271
			273
			275
			277
Module	M0829:	Foundations of Management	280
Focus E		nanics 2	283
Module	M1277:	MED I: Introduction to Anatomy	283
			285
			287
			289
		DIO I. Issaelanda and Frankum Hankina	291 292
			292 294
			295
			296
			296
			_ = <del>=</del> .

Module M0655: Computational Fluid Dynamics I	299
Module M0639: Gas and Steam Power Plants	301
Module M0684: Heat Transfer	304
Module M1022: Reciprocating Machinery	306
Focus Aircraft Systems Engineering	309
Module M0597: Advanced Mechanical Engineering Design	309
Module M0596: Advanced Mechanical Design Project	312
Module M1320: Simulation and Design of Mechatronic Systems	314
Module M0599: Integrated Product Development and Lightweight Design	316
Module M0767: Aeronautical Systems	318
Focus Materials in Engineering Sciences	320
Module M0597: Advanced Mechanical Engineering Design	320
Module M0988: Structural Materials	323
Module M0662: Numerical Mathematics I	325
Module M1009: Material Science Laboratory	327
Module M1005: Enhanced Fundamentals of Materials Science	329
Focus Mechatronics	332
Module M0597: Advanced Mechanical Engineering Design	332
Module M0708: Electrical Engineering III: Circuit Theory and Transients	335
Module M1320: Simulation and Design of Mechatronic Systems	337
Module M0777: Semiconductor Circuit Design	339
Module M0854: Mathematics IV	342
Focus Product Development and Production	345
Module M0597: Advanced Mechanical Engineering Design	345
Module M0596: Advanced Mechanical Design Project	348
Module M0726: Production Technology	350
Module M1009: Material Science Laboratory	353
Module M0599: Integrated Product Development and Lightweight Design	355
Focus Theoretical Mechanical Engineering	357
Module M0597: Advanced Mechanical Engineering Design	357
Module M0684: Heat Transfer	360
Module M1320: Simulation and Design of Mechatronic Systems	362
Module M0596: Advanced Mechanical Design Project	364
Module M0854: Mathematics IV	366
Specialization Process Engineering	369
Module M0886: Fundamentals of Process Engineering	369
Module M0937: Physical Chemistry	371
Module M0536: Fundamentals of Fluid Mechanics	373
Module M0544: Phase Equilibria Thermodynamics	375
Module M0672: Signals and Systems	378
Module M0938: Bioprocess Engineering - Fundamentals	380
Module M0891: Informatics for Process Engineers	382
Module M1274: Environmental Technology	385
Module M0538: Heat and Mass Transfer	387
Module M0546: Thermal Separation Processes	389
Module M0892: Chemical Reaction Engineering	394
Module M1275: Environmental Technology	398
Module M0956: Measurement Technology for Mechanical and Process Engineers	400
Module M0539: Process and Plant Engineering I	403
Module M0670: Particle Technology and Solids Process Engineering	406
Module M0829: Foundations of Management	408
Thesis	411
Module M-001: Bachelor Thesis	411



# **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, some of them with further specialisations. GES is designed as an intensive course of studies, with a higher workload than 180 credit points. The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studyies, 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.

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, some of them with further specialisations. GES is designed as an intensive course of studies, with a higher workload than 180 credit points. The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master study, of another technical or of an economic oriented Master study. Most of the modules in the 1<sup>st</sup> and the 2<sup>nd</sup> semester of GES are offered in English.



# Core qualification

Module M0701: Chemistry (GES)				
-				
Courses				
Title		Тур	Hrs/wk	CP
Chemistry (GES) I (L0467)		Lecture	2	2
Chemistry (GES) I (L0478)		Recitation Section (large)	1	1
Chemistry (GES) II (L0469)		Lecture	2	2
Chemistry (GES) II (L0479)		Recitation Section (large)	1	1
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (English program): Core qualification: Com	pulsory		
Curricula				

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

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



Course L0	1469: Chemistry (GES) II
Тур	Lecture
Hrs/wk	2
CP	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Dr. Christoph Wutz
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 apllications 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. Christoph Wutz
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0736: Linear Alge	bra			
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	School mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge Skills	<ul> <li>Students can name the basic concepts in linear algebra. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	Computer Science: Core qualification: Compulsory			
Curricula	General Engineering Science (English program): Core qualifica	tion: Compulsory		

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

Course 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. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L0645: Linear Algebra	
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0745: Electrical E	ngineering I			
Courses				
Title		Тур	Hrs/wk	CP
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				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students know the basic theory, relations and methods of dir	rect current networks and of electric and m	nagnetic fields. This in	cludes especially:
	Kirchhoff's voltage and current laws,			
	Ohm's law,			
	<ul> <li>methods to simplify and analyze direct current networks,</li> </ul>			
		rial field quantities		
	<ul> <li>description of electric and magnetic fields by use of vectorial field quantities,</li> <li>Basic material relations.</li> </ul>			
	,			
	• Gauss's law,			
	Ampère's law,     industrian law.			
	induction law,  Mayurally a susting in the integral force.			
	Maxwell's equation in the integral form,			
	<ul> <li>concept and definition of resistance, capacitance and ind</li> </ul>	dictance.		
Skills	The students are able to establish relations between currents and voltages in simple direct current networks and to apply these to calculate an		these to calculate and	
	dimension networks. Student know to apply the fundamental law	vs of electric and magnetic fields and are	able to derive and ev	aluate relations betwee
	field quantities. Students know to calculate resistance, capacitan	ce and inductance of simple geometric ar	rrangements.	
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a group	and to present the results accordingly. S	Students can explain o	oncents and on the basi
ooda oompetence	of examples verify and deepen their understanding.	and to present the results accordingly.	nadonio dan explain d	Shoopis and on the basi
	or examples verify and deepen their understanding.			
Autonomy	Students are able to acquire particular knowledge using textbo	ook in a self-learning process, to integra	te, present and assoc	iate this knowledge wit
	other fields. The students develop perseverance to also solve me	ore complicated problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (English program): Core qualificat	ion: Compulsory		
Curricula	25 2g			
Juricula				

Course L0677: Electrical Engineering	ng I	
Тур	Lecture	
Hrs/wk	3	
CP	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Manfred Kasper	
Language	EN	
Cycle	WiSe	
Content	1. Basics of Resistive Circuits 2. Simplifying Resistive Circuits 3. Network Analysis 4. The Electrostatic Field 5. Stationary Currents in Conductive Media 6. Electrostatic Field in Non-Conductive Media 7. Static Magnetic Field 8. Induction and Time-Dependent Fields	
Literature	<ol> <li>M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013</li> <li>A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008</li> <li>P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996</li> <li>M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004</li> <li>F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005</li> </ol>	



Course L0679: 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 M1081: Mechanics	I (GES)			
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				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The primary purpose of the study of Statics is to develop the ca	apacity to predict the effects of forces o	n rigid bodies, structu	ral elements and simple
	structures, which are at rest (in equilibrium). Such a capacity is cr	itical to the design of many structural or	engineering systems.	The particular objectives
	of this course are to:			
		and the affects of forces and indian		
	Introduce the student to the basic principles required to	analyse the ellects of forces applied to	rigia bodies, structui	rai elements and simple
	structures in equilibrium;	ridealized mathematical models of real	anainaarina avatama:	
	Demonstrate sound techniques of constructing and solving     Promote the analytical and problem-solving skills required			
	3. Fromote the analytical and problem-solving skills required	to solve a wide variety of real engineeri	ng problems ellectiver	у.
Skills	At the end of this course the student is able to:			
	Apply the properties of two- and three-dimensional force s	ystems to the analysis of structural eleme	ents and simple structu	ıres in equilibrium.
	2. Isolate a body in equilibrium by drawing its free-body diago	ram on which all forces acting on the boo	dy are represented.	
	3. Analyse the external effects of forces acting on a single bo	dy or a system of bodies in two- and thre	ee-dimensional equilib	orium using the free-body
	diagram of the body or system.			
	<ol> <li>Analyse the internal forces in trusses and beams.</li> </ol>			
	<ol><li>Solve problems of equilibrium with account for dry friction.</li></ol>			
	6. Determine mass centres and centroids of lines, areas and	volumes.		
Personal Competence				
Social Competence	Students can: - work in groups and report on the findings, - de	velop joint solutions in mixed teams a	nd present them to o	thers, - assess the team
	collaboration and their own share in it.			
Autonomy	Students are able to: - solve the problems independently with the	help of hints, - assess their own strength	s and weaknesses, e.	g. with the aid of the mid-
	term test.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	1.5 hours Statics: force systems, equilibrium, mass center, friction,	trusses, beams.		
Assignment for the Following	General Engineering Science (English program): Core qualification	n: Compulsory		
Curricula				

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



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



Module M1139: Physics for	Engineers (GES)			
Courses				
Title		Тур	Hrs/wk	СР
Physics for Engineers (GES) (L0557)		Lecture	2	3
Physics for Engineers (GES) (L0560)		Recitation Section (small)	1	1
Physics-Lab for ET/ AIW/ GES (L0948)		Laboratory Course	1	2
Module Responsible	Dr. Alexander Petrov			
Admission Requirements	None			
Recommended Previous	Calculus and linear algebra on high school level			
Knowledge				
	Physics on high school level			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics su	ch as in the areas of mechanics, oscillation	S,	
	waves, and optics.			
	Students can relate physics topics to technical problems.			
Skilla	Students can describe physical problems mathematically and so	due auch problems within the fremowerk of		
Skills	their acquired mathematical expertise.	nive such problems within the framework of		
	their acquired mathematical expertise.			
	Students are able to write meaningful reports on experiments an	d to discuss the results in a conclusive way	r.	
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups. The	ney can present their results effectively		
	within the framework of the problem solving and lab courses.			
Autorom	Children are associated to authority relationship for the theory of			haf tha last up. They say
Autonomy	Students are capable to extract relevant information from the p			•
	reflect their acquired level of expertise with the help of lecture	accompanying measures such as exam	iypicai exam quesiid	ons. Students are able to
	connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min, 10 problems with two parts a) and b) plus physics lab a	ttestation		
Assignment for the Following	General Engineering Science (English program): Core qualification	tion: Compulsory		
Curricula				
I.				

Course L0557: Physics for Engineer	rs (GES)	
, ,	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	<ul> <li>Introduction</li> <li>Kinematics and dynamics</li> <li>Work, Energy, momentum</li> <li>Rotatory Motion, moments of inertia</li> <li>Gravitation</li> <li>Special Theory of Relativity</li> <li>Oscillations</li> <li>Waves</li> <li>Geometrical optics</li> <li>Wave optics</li> <li>Matter waves</li> <li>Fundamentals of quantum mechanics</li> </ul>	
Literature	<ul> <li>D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics – Extended Edition, 7<sup>th</sup> ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornton and Physics by Tipler and Mosca.</li> </ul>	



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

Course L0948: Physics-Lab for ET/ AIW/ GES		
Тур	Laboratory Course	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hansen	
Language	DE/EN	
Cycle	SoSe	
Content	In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and	
	optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in the course "Physics for TUHH-ET Engineers".	
	Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of physical equipment, analysis of the results and preparation of a report on the experimental data.	
Literature	Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.	
	Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung "Physik für TUHH-ET Ingenieure" angegebene Literatur gut geeignet ist.	



Mobile Responsible  Mobile Responsible  Alteristic Requiremental  Note  Recommended Previouse  Knowledge  Educational Objectives  After bilding part successfully, students have reached the following learning results  Professional Completions  The Monischnical Elective Study Area  insparts skills that, in even of the TURFIS's fairing profile, professional engineering skildes require but are not able to cover fully. Selfer  management, collaboration and prosessional and personnel management completences. The department implements these training of the study program of conditional and personnel management completences. The department implements these training objects to profile or collaboration and present implementation of the study on the profile objects of the study program of the collaboration and present and complementary courses.  The Learning Architecture  consists of a cross disciplinarity study oftening. The controlly designed teaching dering ensures that courses in the monitorinoid department specific presentage and a complementary courses.  The learning architecture derivative department and trains independent educational planning as regards the individual development of complementary courses.  The learning architecture are marked and a study in the first standards and a study oftening ensures that courses in the monitorinoid department or the adaption professor that individual commonly fairs in the first standards after making the trainage from a study or controllaboration professor than individual commonly fairs in the first standards after making the trainage from a study or course and a study program. If need the, it can be studied in one to be owner or the adaption professor that individual commonly fairs in the first standards after making the trainage from the accountage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semisters fairing studies, assessment or a study or study or the subjects of the course of the profile or profile or the	
Admission Requirements  Recommended Princips  Chromology  Educational Objectives  Professional Competence  Professional C	
Recommended Previous  Novelege  Educational Objectives  And tribuling part successfully, students have resorted the billowing learning results  Professional Competence  The Non-technical Elective Study Area  and parts skills that, in view of the TUHH's varieng profile, professional engineering studies require but are not able to cover fully. Skill- arrangements, collaboration and precisional and approach competences. The department implements these raining of  tracking architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which student  by coting for specific competences and a competence level at the Buchlor's or Master's level. The searning delerings are pooled in  catalogues for monistratical competences and a competence level at the Buchlor's or Master's level. The searning delerings are pooled in  catalogues for monistratical competences and a competence level at the Buchlor's or Master's level. The searning delerings are pooled in  catalogues for monistratical competences and a competence level at the Buchlor's or Master's level. The searning architecture  consists of a cost-despirating study offering. The centrally designed leaching offering ensures that courses in the "non-technical department  specific profiling of TUHH degree courses.  The learning architecture demands and values independent educational planning as regards the individual development of competences. It is  the subject that can be studied in parallel throughout the student entire study program – in need be, it can be studied in one to two search of the acaptation processes and the search entire study program—in need be, it can be studied in one to two search of the acaptation processes and the search entire study program—in need to be, it can be studied in one to two search of the acaptation processes and the search of the acaptation in t	
Educational Objectives  Professional Competence  Rosewinding  The Non-technical Elective Study Area  mass state of the Non-technical Competence of the Non-technical enginements flower and a competence of the Internation of Massir's level. The ideal-time of the state stating objective on the Study of the Non-technical department on the Non-technical department on the Non-technical department of the Study Area of the Study Internation of the Internation of Non-technical department operation of the Internation Non-technical department of the Internation Non-technical department operation of the Internation Non-technical department of the Internation Non-technical Internation Non-t	
Professional Competence  Financial Competenc	
Professional Competence  Frontedger  The Non-technical Elective Study Area  Impacts stalls that, in view of the TUNH's training profile, professional engineering studies require but are not able to cover fully. Self- management, collaboration and professional and personnel management competences. The department implements these training due  to spinling representative, in its exheming and learning arrangements, in technique area and so manse of teaching defining area  by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in  catalogues for nontechnical complementary courses.  The Learning Architecture  consists of a cross-disciplinarily study offering. The centrally designed leaching offering ensures that courses in the "non-technical department specific profiling of TUNH's degree courses.  The learning architecture demands and trains independent educational planning as regards the individual development of competences. It is designed to the competence of the adaption brokewise that individuals commonly been inhe first exmedite after making the transition from social control or individuals commonly been inhe first exmedites after making the transition from social control or individuals commonly been inhe first exmedites after making the transition from social 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 dealing with internal and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, and, historical studies, communication sustainability research, and from engineering distalcts. In addition, from the viener semester 2014/15 students on all Bachelor's courses opporturilly to learn about business management and start-upon in a g	
Impairs skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-management, collaboration and professional and personnel management competences. The department implements these training objectives by opting for specific competences and a competence level at the Bachelor's or Mester's level. The teaching oftenings are pooled in catalogues for nontechnical complementary courses.  The Learning Architecture  consists of a cross-disciplinarity study oftening. The centrality designed leaching offering ensures that courses in the "non-technical department specific profiling of TUHH's degree courses.  The learning architecture demands and trains independent educational planning as regards the individual development of compotences. It is consistent in the provided 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 to two seme of the adaptation profilems that individuals commonly face in their first semiesters after reaking the transition from school to university and encurses individually planned semseters abroad, there is no obligation to study these subjects in one or two specific semseters alter individually planned semseters abroad, there is no obligation to study these subjects in one or two specific semseters during its studies.  Teaching and Learning Arrangements  provide for students, separated into B Sc. and M Sc., to learn with and show each other across semesters. The challenge of dealling with inte and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, aris, historical studies, communication sustainability beaarch, and from engineering dicactics. In addition, from the winter semester 2014/15 students on all Bachelor's sund Master's pro	
management, collaboration and prefessional and personnel management completences. The department implements hase animal to treaching are prefessional to the scholar paragraphements, in teaching are and the paragraphement of the Bachelor's or Massier's level. The teaching offerings are pooled in catalogues for notochnical complementary courses.  The Learning Architecture  consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the "non-technical department specific profiling of TUHH degree courses."  The learning architecture demands and trains independent educational planning as regards the individual development of competences. It is offered to the study of the st	
consists of a cross-disciplinarily study offering. The centrally designed teaching ensures that courses in the "non-technical department specific profiling of TUHH degree courses."  The learning architecture demands and trains independent educational planning as regards the individual development of competences. It is criedation 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 to two seme of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university an encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during it 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 dealing with inte and a variety of tauges of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didiactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start ups in a goal-oriented vay.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific	ojective nts can
specific profiling of TUHH degree courses.  The learning architecture demands and trains independent educational planning as regards the individual development of competences. It is 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 to two seme of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university an encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during it 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 dealing with inte and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering disactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co skills, e.g. the skills required by outgoing engineers in international and interrutural 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theories and Master's graduates in their future working life.  Specialized Competence (Knowledge)  Students can  • locate selected specia	
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 to two seem of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university an encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during it 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 dealing with inter and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theor 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 leadership functions and Master's graduates in their future working life.  Specialized Competence (Knowledge)  Students can  • locate selected specialized ar	ent" foll
of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university an encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during 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 dealing with inte and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didactes. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills oftens and a foreign language ofter. Here, the focus is on encouraging goal-oriented coskills, 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theor 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 leadership functions and Master's graduates in their future working life.  Specialized Competence (Knowledge)  Students can  • locate selected specialized areas with the relevant non-technical mother disciplines in the disciplines represented in the learning in different specialist disciplines relate to their own discipline and different take in a late	also pr
provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with inter and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theore 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 leadership functions 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 the learning of 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 representation in the sciences are subject to individual and socio-cultural interpretatio	nd in o
and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.  Fields of Teaching  are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theor 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 leadership functions 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 the learning of different specialist disciplines relate to their own disciplines, paradigms, models, instruments, methods and forms of representation in the sciences are subject to individual and socio-cultural interpretation and historicity, • Can communicate in a foreign language in a manner appropriate to the subject.  Frofessional Competence (Skills)  In selected sub-areas students can • apply basic methods of the said scientific disciplines, • auestion a specific tech	
are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theory 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 leadership functions 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 artists techniques in the disciplines represented in the learning of the 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 representation in the 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  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, afor	ərdiscip
sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses opportunity to learn about business management and start-ups in a goal-oriented way.  The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented co 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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theor 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 leadership functions: 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 the learning of the different professional differentiate it as well as make connections, • sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the 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 specialist discipline,	
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. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theory 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 leadership functions 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 the learning of 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 representation in the 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 specialist discipline,	
of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theor 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 leadership functions 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 the learning of 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 representation in the 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 specialist discipline,	ommun
in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theory 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 leadership functions and Master's graduates in their future working life.  Specialized Competence (Knowledge)  Students can  I 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 the learning and 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 representation in the 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 specialist discipline,	
and Master's graduates in their future working life.  Specialized Competence (Knowledge)  Students can  I 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 the learning and 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 representation in the 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 specialist discipline,	
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 the learning a 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 representation in the 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 specialist discipline,	of Bac
<ul> <li>locate selected specialized areas with the relevant non-technical mother discipline,</li> <li>outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul> Skills Professional Competence (Skills) In selected sub-areas students can <ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> </ul>	
<ul> <li>locate selected specialized areas with the relevant non-technical mother discipline,</li> <li>outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning and different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul> Skills Professional Competence (Skills) In selected sub-areas students can <ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> </ul>	
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 specialist discipline,	
<ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> </ul>	
<ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> </ul>	
<ul> <li>to handle simple questions in aforementioned scientific disciplines in a sucsessful manner,</li> <li>justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship subject.</li> </ul>	tionship
Personal Competence	
Social Competence   Personal Competences (Social Skills)	

- - $\bullet \hspace{0.1in}$  to learn to collaborate in different manner,
  - to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,
  - to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this studyfocus 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

С				

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



Module M0671: Technical 1	Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics I (L0437)		Lecture	2	4
Technical Thermodynamics I (L0439)		Recitation Section (large)	1	1
Technical Thermodynamics I (L0441)		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous	Elementary knowledge in Mathematics and Mechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lear	ning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamic. They know the	e relation of the kinds of energy ac	cording to 1st law of	Thermodynamic and are
	aware about the limits of energy conversions according to 2 <sup>nd</sup> law of T	hermodynamic. They are able to d	istinguish hetween sta	te variables and process
	variables and know the meaning of different state variables like temp			
	able to draw the Carnot cycle in a Thermodynamic related diagram. The			
	use the related equations of state. They know the meaning of a fundam			-
	asset the related equations of state. They know the meaning of a fundam	ionial state of equation and know a	e basies of two priase	memodynamic.
Skills	Students are able to calculate the internal energy, the enthalpy, the kir	netic and the notential energy as we	all as work and heat for	r eimple change of etates
Skills	and to use this calculations for the Carnot cycle. They are able to calculations	1 07		
	variables.	cuiale state variables for all fuedi a	ind for a real gas from	measured mermai state
	variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an appro	aach		
· ·	Students are able to define independently tasks, to get new knowledge		a to find ways to use th	a knowladge in prostice
Autonomy	Students are able to define independently tasks, to get new knowledge	riioiii exisiirig kriowledge as well a	s to lind ways to use th	e knowledge in practice.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Core qualification: C	ompulsory		
Curricula	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsor	ry		
	General Engineering Science (English program): Core qualification: Co	ompulsory		
	Computational Science and Engineering: Specialisation Engineering S	Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Elective Cor	mpulsory		
	Process Engineering: Core qualification: Compulsory			



Course L0437: Technical Thermody	namics I
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	SoSe
Content	1. Introduction
	2. Fundamental terms
	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	
=1.0.4.4.0	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
	- Daws M. Caranta C. Thermodynamics to Engineers Mc Carallill 1000
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

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

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



Module M0737: Mathematic	eal Analysis			
Courses				
Title		Тур	Hrs/wk	CP
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				
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge Skills	<ul> <li>Students can name the basic concepts in analysis. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> <li>Students can model problems in analysis with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	Computer Science: Core qualification: Compulsory			
Curricula	General Engineering Science (English program): Core qualificat	ion: Compulsory		

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. Francisco Javier Hoecker-Escuti	
Language	EN	
Cycle	SoSe	
Content	Convergence, sequences, and series	
	Continuity	
	Elementary functions	
	Differential calculus	
	Integral calculus	
	Sequences of functions	
Literature	Königsberger: Analysis	
	Forster: Analysis	

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



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



Module M0772: Electrical E	ngineering II			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering II (L0747)		Lecture	3	5
Electrical Engineering II (L0748)		Recitation Section (small)	2	1
Module Responsible	Prof. Frank Gronwald			
Admission Requirements	None			
Recommended Previous	Content of the Lecture "Electrical Engineering I (Elektrotechnik I)	п		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students know the basic theory, relations and methods of	time dependent network theory and basic	nonlinear circuit ele	ments. This includes, in
	particular:			
	• transients,			
	the use of complex numbers and phasors,			
	the concept of impedance,			
	steady state sinusoidal circuit analysis,			
	complex power and 3-phase systems,			
	• transformers,			
	transfer function and filters,			
	• the concept of resonance,			
	diodes and rectifiers,			
	<ul> <li>bipolar transistors and operational amplifiers</li> </ul>			
Skills	The students are able to establish relations between time deper	ndent currents and voltages in linear netwo	orks. The students kn	ow how to apply network
	theory to analyze 3-phase systems, transformers, filter-like stru			
	elements, such as diodes, bipolar transistors, and operational ar	nplifiers, into the network analysis.		
Personal Competence				
Social Competence	Students are able to solve specific problems, alone or in a group		udents can explain co	oncepts and, on the basis
	of examples and exercises, verify and deepen their understanding	ng.		
Autonomy	Students are able to acquire particular knowledge using textbo	oks in a self-learning process to integrate	nresent and accord	riate this knowledge with
Autonomy	other fields. The students develop persistency to also solve more		e, present, and assoc	late this knowledge with
	other helds. The stadents develop persistency to also serve more	o complicated problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (English program): Core qualificat	ion: Compulsory		
Curricula	3 3 <del>1 3                </del>	F 7		
341110414				

Course L0747: Electrical Engineerin	ng II
	Lecture
Hrs/wk	
CP	
Cycle	SoSe
Content	<ul> <li>Transients</li> <li>Periodic and sinusoidal signals</li> <li>Power in AC circuits</li> <li>Three-phase systems</li> <li>Transformers</li> <li>Harmonic analysis, transfer functions, filters, locus curve, and Bode plot</li> <li>Resonant circuits</li> <li>Diodes and nonlinear circuits</li> <li>Bipolar transistor and operational amplifier</li> </ul>
Literature	A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)  M. Albach: "Elektrotechnik", (Pearson, 2011).



Course L0748: Electrical Engineering II		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Frank Gronwald	
Language	EN	
Cycle	SoSe	
Content	The exercise sessions serve to deepen the understanding of the concepts of the lecture.	
Literature	A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)  M. Albach: "Elektrotechnik", (Pearson, 2011).	



Courses				
itle		Тур	Hrs/wk	CP
Mechanics II (GES) (L1417)		Lecture	2	3
Mechanics II (GES) (L1418)	I	Recitation Section (large)	2	3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous				
Knowledge Educational Objectives	After telling and account illustrate to a second attacks follows:	a la susina usa culta		
	After taking part successfully, students have reached the following	g learning results		
Professional Competence  Knowledge	The primary purpose of the study of Mechanics of Materials/So	lide is to develop the conseity to predict the	o offeets of forces on	alastia badiaa atrustu
Knowledge	elements and simple structures, which are at rest (in equilibrium			
	particular objectives of this course are to:	. Such a supporty is similar to the design of	many suddiction of c	rigincering systems. I
	Introduce the student to the basic principles required to	analyse the effects of forces applied to e	elastic bodies, structu	ral elements and simp
	structures in equilibrium;	and the effect of the entire first and the effect of		
	Demonstrate sound techniques of constructing and solvil     Promote the analytical and problem-solving skills require	lealised mathematical models of real engineering systems;		
	5. Fromote the analytical and problem-solving skills require	d to solve a wide variety of real engineering	ig problems ellectiver	у.
Skills	At the end of this course the student should be able to:			
	Determine average normal and shear stresses.			
	Determine shear stresses and the angle of twist due to to	rsion of a circular shaft.		
	Determine thermal stresses in rods.			
	Analyse statically indeterminate rods and shafts			
	5. Determine area moments of inertia as well as principal a	es and moments of inertia.		
	6. Determine normal and shear stresses as well as deflection	ns due to bending.		
	<ol><li>Analyse plane state of stress (stress transformation).</li></ol>			
	8. Analyse stability of equilibrium of simple systems and buckling of elastic columns.			
	Determine displacements and solve statically indetermin	ate problems with the aid of energy (Castig	ıliano's) method.	
	1.			
	1.			
Personal Competence				
Social Competence	Students can: -work in groups and report on the findings, - d	evelop joint solutions in mixed teams an	d present them to o	thers, - assess the te
,	collaboration and their own share in it.			
Autonomy	Students are able to; - solve the problems independently with	he help of hints, - assess their own streng	ths and weaknesses	, e.g. with the help of
	mid-term test.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	1.5 hours Mechanics of Solids: stress and strain due to axial	loading, torsion, bending, stress transfor	mation, moments of	inertia, buckling, ene
	methods.			
Assignment for the Following	General Engineering Science (English program): Core qualification	on: Compulsory		
Curricula				



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

Course L1418: Mechanics II (GES)	Course 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				
ïtle		Тур	Hrs/wk	CP
rogramming in C (L0083) rogramming in C (L1488)		Leberatory Course	1	1
Module Responsible	Prof. Siegfried Rump	Laboratory Course	'	ı
Admission Requirements	None			
Recommended Previous	Elementary PC handling skills			
Knowledge	Elementary i o nariding skins			
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	The students know by heart the basic syntax of C programming	as well as its meaning, intent and		
	purpose.			
	They know the fundamental components and principles of class	agentary, proceedural programming		
	They know the fundamental components and principles of elembased on C programming and can explain them:	lemary procedural programming		
	based on o programming and can explain them.			
	basic data types (integers, floating point numbers, characters)			
	advanced data types (pointers, arrays, strings, composed data			
	operators (arithmetical operations, logical operations, bit operations)	ations)		
	control flow (choice, loops, jumps, conditional compilation)     functions and macros			
	important standard libraries and functions			
	• recursion			
	• linked lists			
	The students are prepared for continuing programming lecture	s like object oriented programming in C++		
Skills	The students know how to use an integrated development envi	ronment for C programming on a PC		
	so that they can write, store, compile and execute C programs	on it.		
	Using their knowledge they are able to read and understand gi	ven C Programs.		
	They can solve simple algorithmic problems on their own and o in C language.	ean model and program their solutions		
	iii o language.			
	The students are able to solve selected exercises from other ar	eas of their study like mathematics,		
	mechanics, electrical engineering or physics with the aid of sm	all C programs/-projects numerically.		
Personal Competence				
Social Competence	The students are able to work in small teams to solve given we	ekly tasks, to identify and analyze		
	programming errors and to present their results.			
	They are able to explain simple phenomena to each other dire	adio ad the DO		
	They are able to explain simple phenomena to each other dire	Buy at the FO.		
Autonomy	The students prepare themselves using the given teaching ma	erial and solve the given		
	programming exercises on their own.			
	Additionally, they write small C programs to understand and ch	eck addressed issues and also to		
	gain a certain programming experience.			
	For details have add the same of the best on the state of the	Alexander and a series of		
	For details beyond the scope of the lecture the students inform	tnemselves using the stated		
	literature and / or by supplementary own research.			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Credit points	2			
Examination	Homework			
Examination duration and scale	1-2 coding tasks weekly			
Assignment for the Following	General Engineering Science (German program): Core qualific	ation: Compulsory		
Curricula	General Engineering Science (English program): Core qualific	ation: Compulsory		



Course L0083: Programming in C	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump
Language	DE/EN
Cycle	SoSe
Content	C-Programming:
	<ol> <li>basic data types (integers, floating point numbers, characters, boolean values)</li> <li>advanced data types (pointers, arrays, strings, composed data types, type conversion)</li> <li>operators (arithmetical operations, logical operations, bit operations)</li> <li>control flow (choice, loops, jumps, conditional compilation)</li> <li>functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers)</li> <li>important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)</li> <li>example programs for technical and mathematical applications</li> </ol>
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	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0594: Fundament	tals of Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Mechanical Engineering Design (L0258)		Lecture	2	3
Fundamentals of Mechanical Engineering		Recitation Section (large)	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	Basic knowledge about mechanics and production engineering  Laterachia (Otera I Breatian))			
	Internship (Stage I Practical)			
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
1	explain basic working principles and functions of machine elements.	nts.		
	explain requirements, selection criteria, application scenarios a		hine elements ind	icate the background of
	dimensioning calculations.			
Skills	After passing the module, students are able to:			
	<ul> <li>accomplish dimensioning calculations of covered machine eleme</li> </ul>	nts,		
	<ul> <li>transfer knowledge learned in the module to new requirements ar</li> </ul>	nd tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings and schematic sketch</li> </ul>	es,		
	technically evaluate basic designs.			
Personal Competence				
Social Competence				
,,,,,	Students are able to discuss technical information in the lecture state.	upported by activating methods.		
Autonomy				
,	Students are able to independently deepen their acquired knowledge.	dge in exercises.		
	Students are able to acquire additional knowledge and to recall	apitulate poorly understood content	e.g. by using the	video recordings of the
	lectures.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Core qualification: Cor	npulsory		
Curricula	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Core qualification: Con	pulsory		
	Logistics and Mobility: Core qualification: Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			



Course L0258: Fundamentals of Me	chanical Engineering Design
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Lecture
	Introduction to the following machine elements  Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts  Presentation of technical objects (technical drawing)
	Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axis & shafts
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>

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



Module M0688: Technical 1	hermodynamics II			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics II (L0449)		Lecture	2	4
Technical Thermodynamics II (L0450)		Recitation Section (large)	1	1
Technical Thermodynamics II (L0451)		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous	Elementary knowledge in Mathematics, Mechanics and Technica	Thermodynamics I		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are familiar with different cycle processes like Joule, Otte exergetic efficiencies and know the influence different factors. The cooling cycle). They have increased knowledge of steam cycles know the laws of gas mixtures, especially of humid air processes knowledge in gas dynamics and know the definition of the speed	ey know the difference between anti clo and are able to draw the different cycl and are able to perform simple combus	ckwise and clockwise es in Thermodynamic stion calculations. The	cycles (heat-power cy cs related diagrams. The
Skills	s Students are able to use thermodynamic laws for the design of technical processes. Especially they are able to formulate energy, exergy- and entrop balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from a tan They are able to transform a verbal formulated message into an abstract formal procedure.			
Personal Competence Social Competence Autonomy	The students are able to discuss in small groups and develop an Students are able to define independently tasks, to get new know		is to find ways to use th	he knowledge in practi
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
		on: Compulsory		
Assignment for the Following Curricula	General Engineering Science (German program): Core qualificati General Engineering Science (German program, 7 semester): Co			
Curricula	Bioprocess Engineering: Core qualification: Compulsory	re qualification. Compulsory		
		wleen,		
	Energy and Environmental Engineering: Core qualification: Comp			
	General Engineering Science (English program): Core qualification			
	General Engineering Science (English program, 7 semester): Con			
	Computational Science and Engineering: Specialisation Enginee	ring Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elec	tive Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			
	Process Engineering: Core qualification: Compulsory			



Course L0449: Technical Thermody	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	<ul> <li>Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009</li> <li>Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012</li> <li>Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993</li> </ul>		

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

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



Module M1105: Mechanics	III (GES)			
Courses				
Title		Тур	Hrs/wk	CP
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. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	The primary purpose of the study of Mechanics III (Fluid Statics, Kin	ematics and Kinetics) is to develop	the capacity to predict	the effects of forces and
	motions, necessary for the analysis and design of moving machine	parts, different machinery, vehicles,	aircraft, spacecraft, au	tomatic control systems,
	etc.The particular objectives of this course are to:			
	Determine the hydrostatic forces acting on different objects.			
	Analyse stability of floating bodies.			
	Analyse the kinematics and kinetics of a particle in different	•		
	Analyse the motion of the system of particles and forces actin			
	Analyse the plane motion of a rigid body (simple mechanism)			
	Analyse the three-dimensional motion of a rigid body and force	es acting on it.		
Skills	At the end of this course the student should be able to:			
	Solve the equilibrium problems with account for hydrostatic properties.	essure forces.		
	Analyse stability of simple floating bodies.			
	3. Calculate the velocity and acceleration of a particle in different refe	rence systems.		
	4. Derive and solve the equation of motion of a particle in different control of the contro	rent reference systems.		
	5. Analyse the motion of the system of particles and forces acting on	it with the aid of work-energy and imp	oulse-momentum relati	onships,
	Calculate the instantaneous linear and angular velocities and accurate the instantaneous linear ac	elerations of the planar mechanisms.		
	7. Derive and solve the equations of a plane motion of a rigid body a	nd find forces acting on it,		
	Apply work-energy and impulse-momentum relationships to analys	se plane kinetics of a rigid body.		
	Calculate the instantaneous linear and angular velocities and accurate the instantaneous linear accurate t	elerations of the three-dimensional r	motion of a rigid body.	
	10. Derive the equations of a motion of a three-dimensional motion of	of a rigid body.		
	11. Apply in three-dimensional kinematics and kinetics of rigid body	both methods of vector algebra and	matrix methods.	
Personal Competence				
Social Competence	Students can: - work in groups and report on the findings, - devel	op joint solutions in mixed teams a	and present them to of	hers, - assess the team
	collaboration and their share in it.			
Autonomy	Students are able to: -solve the problems independently with the help	o of hints, - assess their own strength	ıs and weaknesses, e.ç	g. with the aid of the mid-
	term test.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 hours Fluid Statics: hydrostatic pressure, buoyancy, stability of floa	ting vessels. Kinematics of particle, of	of plane and 3D rigid b	od,y. Kinetics of particle,
	system of particles, of plane and 3D rigid body. Vector and matrix algo	ebra formulation.		
Assignment for the Following	General Engineering Science (English program): Core qualification:	Compulsory		
Curricula	General Engineering Science (English program, 7 semester): Core q	ualification: Compulsory		
	Computational Science and Engineering: Specialisation Engineering	Sciences: Elective Compulsory		

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



Course L1420: Mechanics III (GES)	
Тур	Recitation Section (small)
Hrs/wk	2
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
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	WiSe
Content	FLUID STATICS
	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, polar coordinates. Space
	curvilinear motion.
	Constrained motion of connected particles.
	3. Plane kinematics of a rigid body.
	Relative (compound) motion.
	5. Three-dimensional kinematics of a rigid body.
	KINETICS
	Kinetics of a particle and of a system of particles.
	Plane kinetics of a rigid body.
	Three-dimensional kinetics of a rigid body.
Literature	1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons, SI Version, 4 <sup>th</sup> Edition
	rd
	2 . R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3 <sup>rd</sup> Edition



Typ Complete Piginerry (1,032)  Module Responsible  Port Heine Fails  Admission Regularimented  Recommended Previous  Knowledge  The successful completion of the labor will be honored during the evaluation of the module's examination  1. Upon a passed module examination, the student is granted a bonus on the examination  amination is made as filted by 0.3 or 0.4, respectively, up to the rest-better grade.  2. The improvement of the grade 5.0 up to 4.3 and of 4.3 up to 4.0 is not possible.  Educational Objectives  Professional Competence  Anowledge  Professional Competence  Professional Competence  Anowledge  Professional Competence  Professional Competence  Professional Competence  Anowledge  Professional Competence  Professional Competence  Professional Competence  Anowledge  Professional Competence  Professi		
Indicate Responsible Module Responsible Module Responsible Admission Requirements Recommended Previous Basic knowledge The successful completion of the labb will be honored during the evaluation of the module's examination 1. Upon a passed module examination, the student is granted a bosus on the crammation annihilation state are filled by 63 or 64, respectively, by the fine new better grade. 2. The improvement of the grade 5.0 up to 4.3 and of 4.3 up to 4.0 is not possible.  Professional Competence Knowledge This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module field includes the believing bypics:  I minoduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware enginesis, combine of Sequential logic: Playfore, automata, systemata hardware design Technological boundations Computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and division Basic of computer arithmetic histoger addion, substaction, multiplication and invividual computers can component. They are alle to disringuish between and to explain the distence abstraction in a computer systems. The state allee to disringuish between and to explain the distence abstraction in a proper and invividual computers can computer systems from the architects perspective, i.e., they identify the incomputer systems from the architects are		
Modulo Responsible Profit Helino Falls Admission Requiremental None Recommended Previous Basic knowledge in electrical engineering The successful completion of the labor will be honored during the evaluation of the modulo's examination examinations marks are titled by 0.3 or 0.4, respectively, up to the nest-bater grade. 2. The improvement of the grade 5.0 up to 4.3 and of 4.3 up to 4.0 is not possible.  Professional Competence Ricoviledge This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following beginning results  Professional Competence Ricoviledge This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following begins:  Introduction Computer arithmetic includes the following begins and profit and division Computer arithmetic includes the following begins and profit and division Computer arithmetic includes the following begins and profit and division Computer Computer Science Computer Systems from the architects and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of up to possible arithmetic profit profit and profit	Hrs/wk	СР
Module Responsible Prof. Heliko Falk Admission Requirements None Recommended Previous Saick involvedge in electrical engineering Recommended Previous Saick involvedge in electrical engineering The successful completion of the labs will be honored during the evaluation of the module's examination avaination's marks are littled by 30 of 4.7 especietys; but be next-better government of the grade 5,0 up to 4.3 and of 4.3 up to 4.0 is not possible.  Educational Objective. After taking part successfully, students have reached the following learning results Professional Competence Annellogy This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following spoce:  • introduction • Combinational logic: Cales, Boolean algebra, Boolean functions, hardware synthesis, combina • Sequential logic: Plipflegos, automata, systematic hardware despine. • Technological fundations • Computer arithmetic Integer addition, subtraction, multiplication and division • Saics of competence  Social Competence  Social Competence  After successful completion of the module, the students are also by layed the interdependencies be executed on it. It particular, they shall understand the computer systems. The students can analyze, low highly specific and individual computers can components. They are all ed to distinguish between and to explain the different eleteration of software the assembly language down to gates. This way, they will be enabled to evaluate the impact that the performance and to propose leasible options.  Personal Competence  Social Competence  Central Engineering Science (German program, 7 semester): Specialisation for Computing Central Engineering Science (German program, 7	3 1	4 2
Admission Requirements Recommended Previous Basic knowledge Knowledge Knowledge Knowledge The successful completion of the labs will be honored during the evaluation of the module's examination examination's marks are filted by Q.3 or Q.4, respectively, up to the next-better grade. 2. The improvement of the grade 5.0 up to 4.3 and of 4.3 up to 4.0 is not possible.  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 lay quates. The module includes the following learning results  - Introduction - Coordinational logic: Cales, Boolean algebra, Boolean functions, hardware synthesis, combin - Sequential logic: Filip-flops, automata, systematic hardware design - Technological foundations - Computer architecture. Programming models, MIPS single-cycle architecture, pipelini - Memorists: Memory Internations, SAM DRAM, caches - Imputious to Computer architecture. Programming models, MIPS single-cycle architecture, pipelini - Memorists: Memory Internations, SAM DRAM, caches - Imputious to Computer systems. The students perceive the cCPU, principles of passing data, point-to-point com- some complete processors.  After successful completion of the module, the skadents are able to judge the interdependencies between and to explain the different abstraction layers of to the computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of to the computer systems. The students can analyze, how highly specific and individual computers can component. They are able to distinguish between and to explain the different abstraction layers of to the computer systems. The students are able to judge the interdependencies between components of the computer systems in the students are able to judge the interdependencies between co		<del>-</del>
Knowledge  The successful completion of the labs will be honored during the evaluation of the module's examination  1. Upon a passed module examination, the student is granted a bonus on the examination  2. The improvement of the gade 5.0 µ by 4.3 and 4.1 and 9.0 his not possible.  Educational Copjectives  After taking part successfully, students have reached the following learning results  Professional Competence  Anowledge  The students pecceled anowledge		
The successful completion of the labs will be honored during the evaluation of the module's examination  1. Upon a passed module examination, the student is granted a bonus on the examination examination manks are lifed by 0,3 or 0.4, respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4.3 and of 4.3 up to 4.0 is not possible.  Educational Objectives  After taking part successfully, skidents have reached the following learning results  Professional Competence  Knowledge  This module deals with the bundations of the functionality of computing systems. It covers the lay gates. The module includes the following topics:  • Enroduction • Combinational logic: Cates, Beolean algebra, Boolean functions, hardware synthesis, combin expensions. • Computer arithmetic histoger addition, subtraction, multiplication and division • Seases of computer architecture. Programming models, MPS single-cycle architecture, pipelini • Memories: Memory hierarchies, SIRAM, DIRAM, caches • Exploitoputs: 05 of mem be prespective of the CPU, prenciple of passing data, point-to-point computer systems from the architects perspective, i.e., they identify the incomputer systems. The students purceive computer systems from the architects perspective, i.e., they identify the incomputer systems. The students purceive computer systems from the architects perspective, i.e., they identify the incomputer systems. The students are able to distinguish between and to explain the different abstraction layers of the security of the subdents are able to solve similar problems alone or in a group and to present the results accordingly.  Assignment for the Following  Automany  Suddents are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours  Indicate the processors.  Personal Competence  Social Competence  Social Competence  Social Competence  Social Competence Social Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Comeral Enginee	-	
1. Upon a passed module examination, the student is grained a bonus on the examination examination's marks are litted by Q.S. or O.A. respectively, up to the next-better grade.  2. The improvement of the grade S.O. up to 4,3 and of 4,3 up to 4,0 is not possible.  Educational Objectives  After taking past 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 lay gates. The module includes the following bipois:  • Introduction • Combinational logic: Cates, Boolean algebra, Boolean functions, hardware synthesis, combin. • Sequential logic: Pilp-tops, automats, systematic hardware dealign • Technological foundations • Computer architecture. Programming models, MIPS single cycle architecture, pipelini • Memories: Memory hierarchies, StAND IRAM, caches • Inputiouput: I/O from the perspective of the CPU, principles of passing data, point-to-point conditions.  Skills  The students perceive computer systems from the architecture programming models, MIPS single cycle architecture, pipelini • Memories: Memory hierarchies, StAND IRAM, caches • Inputiouput: I/O from the perspective of the CPU, principles of passing data, point-to-point conditions.  Alter successful completion of the module, the students are able to judge the interdependencies between and several programming models. The search of sample programming and programming models in the search of sample programming and pr	ion according to the follow	wing rules:
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 lay gates. The module includes the following lopics:  Introduction Compitational logic: Cates, Boolean algebra, Boolean functions, hardware synthesis, combin. Sequential logic: Epideps, austimats, systemats hardware design Technological foundations Computer arithmetic-lineger addition, subtraction, multiplication and division Bases of computer architecture. Programming models, MIPS singler-cycle architecture, pipelin Memories: Memory hierarchies, SRIAM, DRAM, Caches Inputitipup It Officiam the perspective of the CPU, principles of passing data, point-ta-point computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction system of up to complete processors.  Alter successful completion of the module, the students are able to judge the interdependencies between data of the computer systems of the successful completion of the module, the students are able to judge the interdependencies between and to explain the different abstraction system of the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence  Social Competence  General Eng	on according to the lollov	willig rules.
Educational Objectives After tasking part successfully, students have reached the billowing learning results Professional Competence Knowledge This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following topics:  Introduction Compinional topic: Cates, Boolean algebra, Boolean functions, hardware synthesis, combining the computing systems of the computing systems. It covers the lay gates. The module includes the following topics:  Introduction Compinional topic: Cates, Boolean algebra, Boolean functions, hardware synthesis, combining the computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer systems from the architects perspective, i.e., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of tup to compilete processors.  After successful completion of the module, the students are able to judge the interdependencies between the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence Social Forting and Social Competence and the successful compilers of the successful competence and to applicate new knowledge from specific literature and to associate this knowledge is the assembly inspecial and the successful compilers of the successful compilers of the suc	s marks due to the succ	cessful labs, such that t
Professional Competence  Knowledge  This module deals with the foundations of the functionality of computing systems. It covers the lay gaster. The module includes the following topics:  Introduction  Introductio		
Professional Competence Knowledge This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following topics:  Introduction Computer arithmetic integer addition, subtraction, multiplication and division Sequential logic: Filip-flops, automata, systematic hardware design Technological foundations Computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer arithmetic integer addition, subtraction, multiplication and division Basics of computer systems from the architects perspective, i.e., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to dissinguish between and to explain the different abstraction layers of tup to complete processors.  Alter successful completion of the module, the students are able to judge the interdependencies between and to propose feasible options.  Personal Competence  Social Competence  S		
This module deals with the foundations of the functionality of computing systems. It covers the lay gates. The module includes the following bytes:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinions, systematic hardware design Technological bundations Technological bundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetic-integer addition, subtraction, multiplication and division Basics of computer arithmetic-integer addition, subtraction, multiplication and division Basics of computer arithmetic-integer addition, subtraction, multiplication and division Basics of computer arithmetic-integer addition, subtraction, multiplication and division Basics of computer arithmetic-integer addition, subtraction and division Basics of computer arithmetic-integer addition, subtraction and division Basics of computer arithmetic-integer and subtraction and division Basics of computer arithmetic integer and subtraction and division Basics of computer arithmetic integer and subtraction and division Basics of computer arithmetic integer and subtraction and division Basics of computer arithmetic integer and subtraction and sub		
gates. The module includes the following topics:  Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational competence of the computer architecture; Programming models, MIPS single-cycle architecture, pipelini Computer architecture; Programming models, MIPS single-cycle architecture, pipelini Memories: Memory hierarchies, SRAM, DRAM, caches Inputiouptut I/D from the perspective of the CPU, principles of passing data, point-to-point com serving and a service of the computer systems from the architects perspective, i.e., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and so explain the different abstraction layers of the computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and so explain the different abstraction layers of the security of the computer systems. The students are able to judge the interdependencies between the sessential processors.  Alter successful completion of the module, the students are able to judge the interdependencies between the assential processors.  Personal Competence  Social Competence  Social Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Wiritien exam  Examination  Curricula  Assignment for the Following  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Correct Engineering Science (German program, 7 semester): Specialisation Disposess Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Disposess Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Science (German program, 7 semes		
Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combined to Combinational logic: Clates, Boolean algebra, Boolean functions, hardware synthesis, combined to Sequential logic Plip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetics. Integer addition, subtraction, multiplication and division Basics of computer arithmetics. SRAM, DRAM, caches Inputicuptur IU forms the perspective of the CPU, principles of passing data, point-to-point con services. Memories: Memory hierarchies, SRAM, DRAM, caches Inputicuptur IU forms the perspective of the CPU, principles of passing data, point-to-point con components. They are able to distinguish between and to explain the different abstraction layers of tup to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence Social Competence Social Competence Social Competence Autonomy Students are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Examination Curricute  Examination Curricute  Coretif points  Examination duration and scales 30 minutes, contents of course and labs  Assignment for the Following Ceneral Engineering Science (German program, 7 semester): Specialisation Disprocess Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Disprocess Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical	ers from the assembly-le	vel programming down
Combinational logic: Gales, Boolean algebra, Boolean functions, hardware synthesis, combin Sequential logic: Phipops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer arithmetic. Integer addition, subtraction, multiplication and division Memories: Memory hierarchies, SRAM, DRAM, caches Inputouput: Uf form the perspective of the CPU, principles of passing data, point-to-point con  Skills The students perceive computer systems from the architect's perspective, i.e., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of to up to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence  Social Competence  Social Competence  Social Competence  Autonomy Students are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Examination  Examination duration and scale  Assignment for the Following  Certific ploints  Examination  Curricula  Ceneral Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Dismedical Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Sc		
Sequential logic: Flip-flops, automata, systematic hardware design  Technological foundations  Computer arithmetic integer addition, subtraction, multiplication and division  Saciscs of computer architecture. Programming models, MIPS single-cycle architecture, pipelini  Memories: Memory hierarchies, SRAM, DRAM, caches  Inputioruptur: I/O from the perspective of the CPU, principles of passing data, point-to-point con  Skills  The students perceive computer systems from the architects perspective, i.e., they identify the irroducing systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of sup to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Examination  Examination duration and scale  Assignment for the Following  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Correctle points  General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compensal Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Computer Science (German program, 7 semester): Specialisation Mechanical Engineering Ceneral Engineering Science (German program, 7 semester): Speciali		
Technological foundations Computer antimetic: httpser addition, subtraction, multiplication and division Basics of computer antimetic: httpser addition, subtraction, multiplication and division Basics of computer antimetic: httpser addition, subtraction, multiplication and division  Memories: Memory hierarchies, SRAM, DRAM, caches Inputioutput: 10 from the perspective of the CPU, principles of passing data, point-to-point com  Skills The students perceive computer systems from the architect's perspective, i.e., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of tup to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between do nit. In particular, they shall understand the consequences that the execution of software It the assembly language down to gales. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence  Social Competence  Socia	ational networks	
Computer arithmetic: Integer addition, subtraction, multiplication and division Easics of computer architecture. Programming modes, MPS single-cycle architecture, pipelini Nemorises: Memorp hierarchies, SRAM, DRAM, caches Inputioutput: I/O from the perspective of the CPU, principles of passing data, point-to-point com  Skills The students perceive computer systems from the architects perspective. Lie., they identify the incomputer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of the up to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence  Social Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge in Independent Study Time 124, Study Time in Lecture 56  Examination  Examination duration and scale  Assignment for the Following  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Comperal Engineering Science (German program, 7 semester): Specialisation Disprocess Engineering.  General Engineering Science (German program, 7 semester): Specialisation Biometical Engineering. General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.  General Engineering Science (German program, 7 s		
Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelini  Memories: Memory hierarchies, SRAM, DRAM, caches  Input/but/put/ Drom the perspective of the CPU, principles of passing data, point-to-point continued in the computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of the up to compilete processors.  After successful completion of the module, the students are able to judge the interdependencies between and to explain the different abstraction layers of the up to compilete processors.  After successful completion of the module, the students are able to judge the interdependencies between and the consequences that the execution of software is the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy  Students are able to acquire new knowledge from specific literature and to associate this knowledge via the students of the students are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours  Examination duration and scale.  9 bit miles, contents of course and labs  Examination advantage of the students of course and labs  Examination advantage of the students of course and labs  Examination advantage of the students of course and labs  Examination advantage of the students of course and labs  Examination advantage of the students of course and labs  Examination advantage of the students of the		
Personal Competence Social Engineering Science (German program, 7 semester): Specialisation Computer Science: Competence General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German pr		
Inputioutput: I/O from the perspective of the CPU, principles of passing data, point-to-point com   Skills	ng	
Skills  The students perceive computer systems from the architect's perspective, i.e., they identify the is computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of the up to complete processors.  After successful completion of the module, the students are able to judge the interdependencies between components on it. In particular, they shall understand the consequences that the execution of software is the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Morkload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Cornected Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Ceneral Engineering Science (German program, 7 semester): Specialisation Deprocess Engineering: General Engineering Science (German program, 7 semester): Specialisation Process Engineering: General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: General Engineering Science (German program, 7 semester): Specialisation Mechanical En	nections, busses	
computer systems. The students can analyze, how highly specific and individual computers can components. They are able to distinguish between and to explain the different abstraction layers of the up to complete processors.  After successful completion of the module, the students are able to judge the interdependencies beth executed on it. In particular, they shall understand the consequences that the execution of software is the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Social Competence  Suddents 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 is the samination duration and scale  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program; 7 semester): Specialisation Computer Science: Competence Ingineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Devarders Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Science (German program, 7 semester): Specialisation Electrical Engineering General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisatio		
components. They are able to distinguish between and to explain the different abstraction layers of to up to complete processors.  After successful completion of the module, the students are able to judge the interdependencies beth executed on it. In particular, they shall understand the consequences that the execution of software if the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose leasible options.  Personal Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Morkload in Hours  Teamination and the season of the module of the season of the s		
After successful completion of the module, the students are able to judge the interdependencies bethe executed on it. In particular, they shall understand the consequences that the execution of software is the assembly language down to gates. This way, they will be enabled to evaluate the impact that these performance and to propose feasible options.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Examination Mirities exam  Examination duration and scale  Ominutes, contents of course and labs  Curricula  Assignment for the Following  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Corr General Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  Gen		
After successful completion of the module, the students are able to judge the interdependencies between executed on it. In particular, they shall understand the consequences that the execution of software is the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Examination  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Core General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 se	oday's computing system	is - from gates and circl
executed on it. In particular, they shall understand the consequences that the execution of software in the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge in the control of control of the co		
the assembly language down to gates. This way, they will be enabled to evaluate the impact that thes performance and to propose feasible options.  Personal Competence  Scial 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 the control of the c	veen a physical compute	er system and the softwa
performance and to propose feasible options.  Personal Competence  Social Competence  Autonomy  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 of the students are able to acquire new knowledge from specific literature and to associate this knowledge of the students are able to acquire new knowledge from specific literature and to associate this knowledge of the students of the stud		•
Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Morkload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Examination duration and scale  Assignment for the Following  Curricula  Curricula  Curricula  Curricula  Assignment for the Following  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Competency General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Competency General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Science (German program, 7 semester): Specialisation Process Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Science (German program, 7 semester): Specialisation Process Engineering General Engineering Science (German program, 7 semester): Specialisation Process Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical	e low abstraction levels i	have on an entire system
Social Competence Autonomy Students are able to acquire new knowledge from specific literature and to associate this knowledge with the computer of the comput		
Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination Written exam  Examination and scale 90 minutes, contents of course and labs  Assignment for the Following General Engineering Science (German program, 7 semester): Specialisation Computer Science: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Divide Ingineering Science (German program, 7 semester): Specialisation Process Engineering General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Computer Engineering Science (German program, 7 semester): Specialisation Electrical Engineering General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulso		
Terdit points Examination Examination duration and scale  Assignment for the Following Curricula  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Rioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compuneral Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compuneral Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compuneral Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compuneral Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compuneral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compuneral Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compuneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (English program): Core qualifi		
Morkload in Hours   Independent Study Time 124, Study Time in Lecture 56	with other classes.	
Examination   Written exam   Written exam   Semination   Written exam   Semination   Written exam   90 minutes, contents of course and labs   General Engineering Science (German program): Core qualification: Compulsory   General Engineering Science (German program, 7 semester): Specialisation Computer Science: Core   General Engineering Science (German program, 7 semester): Specialisation   Semination   General Engineering Science (German program, 7 semester): Specialisation   Semination   Se		
Examination  Examination duration and scale  90 minutes, contents of course and labs  Assignment for the Following Curricula  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Com General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Com General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Come General Engineering Science (English program, 7 semester): Spe		
Examination duration and scale  Assignment for the Following Curricula  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Com General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Com General Engineering Science (German program, 7 semester): Specialisation Dioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Electrical Engineering: Computer Science (German program, 7 semester): Specialisation Electrical Engineering: Computer Science (German program, 7 semester): Specialisation Electrical Engineering: Computer Science (German program, 7 semester): Specialisation Energy and Environmental General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computer Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Dioprocess Engineering:		
Assignment for the Following Curricula General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Dioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Com General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Comp General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Science: Compulsory		
Curricula  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Com General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Comp General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Comp General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Septimation Science: Com		
General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Company General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Company General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Ceneral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Ceneral Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Ceneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Sempter Science: Computer Science (English program, 7 semester): Specialisation Sempter Science: Computer Science (English program, 7 semester): Specialisation Sempter Science: Computer Science (English	anulaan.	
General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Comgeneral Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Computer Science (German program, 7 semester): Specialisation Electrical Engineering: Computer Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computer Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Specialisation Computer Science: Comgeneral Engineering Science (English program, 7 semester): Specialisation Specialisation Specialisation Computer Science: Comgeneral Engineering Science (English program, 7 semester): Specialisation Specialisation Specialisation Specialisation Specialisation Specialisation Specialisation Sp		
General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Comp. General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Comparison of General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory General Engineering: Core (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering: Core (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering: Core (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering: Core (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering: Core (English program, 7 semester): Specialisation Computer Science: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computer Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering: Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Science Engineering:		
General Engineering Science (German program, 7 semester): Specialisation Energy and Environments General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computer Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program): Core qualification: Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Comp	•	
General Engineering Science (German program, 7 semester): Specialisation Process Engineering: C General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science: Com General Engineering Science (English program, 7 semester): Specialisation Science Scienc	: Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Science: Computer Science: Computer Science (English program, 7 semester): Specialisation Science Science (English program, 7 semester): Specialisation Science	al Engineering: Compulso	ory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Science (English program, 7 semester): Specialisation Science Science Science (English program, 7 semester): Specialisation Science Science Science (English program, 7 semester): Specialisation Science Scien	ompulsory	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Ingineering Science (English program, 7 semester): Specialisation Computer Science: Computer Ingineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Computer Science: Computer Science (English program, 7 semester): Specialisation Computer Science: Computer Ingineering Science (English program, 7 semester): Specialisation Engineering: Computer Science (English program, 7 semester): Specialisation Eng		
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	•	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Comgeneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	ering, Focus Materials	in Engineering Science
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	aring Focus Theoretical	Machanical Engineeri
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	g, 1 0000 THEOTERCAL	oonamoar Engineen
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	ring, Focus Product Dev	elopment and Producti
Computer Science: Core qualification: Compulsory  Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com  General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
Electrical Engineering: Core qualification: Compulsory  General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com  General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:	ı, Focus Energy Systems	: Compulsory
General Engineering Science (English program): Core qualification: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com  General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:		
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Com		
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Comp	•	
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: C General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:		

Technomathematics: Specialisation II. Informatics: Elective Compulsory



General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory

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

Torre	Desiration Continue (continue (continue))
	Recitation Section (small)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	1. Introduction
	District on a district desire
	Principles of digital design     Applications of Rights
	Analog versus Digital     Analog versus Digital
	Gates and flip-flops  Associated fill filled decisions
	Aspects of digital design
	Integrated cicuits
	Digital devices
	Time-to-market
	2. Number Systems and Codes
	General positional number systems
	Representation of numbers
	Binary arithmetic
	Number and character codes
	Codes for detecting and correcting errors
	Codes for serial data transmission
	Binary prefixes
	3. Digital Circuits
	Logic signals and gates
	Logic families
	CMOS logic
	CMOS circuits: electrical behavior
	CMOS input and output structures



- Bipolar logic
- CMOS logic families
- CMOS/TLL interfacing

## 4. Combinational Logic Design (Principles)

- · Switching algebra
- Combinational-circuit analysis
- Combinational-circuit synthesis
- Minimization
- Timing hazards

#### 5. Combinational Logic Design (Practices)

- Documentation standards
- · Timing of digital circuits
- Decoders and encoders
- Three-state devices
- · Multiplexers and demultiplexers
- Exclusive-OR gates and parity circuits
- Comparators
- Adders and subtractors
- Combinational multiplier
- Barrel shifte
- Arithmetic and logic unit (ALU)

#### 6. Sequential Logic Design (Principles)

- · State concept and clock signal
- Bistable elements
- Asynchronous latches
- Synchronous latches
- Synchronous flip-flops
- · Overview: latches and flip-flops
- Clocked synchronous state-machine analysis
- Clocked synchronous state-machine design
- Designing state machines using state diagrams
- Sequential-circuit design with VHDL
- Decomposing state machines

## 7. Sequential Logic Design (Practices)

- Sequential-circuit documentation standards
- Latches and flip-flops
- Counters
- Shift registers
- Iterative versus sequential circuits
- Synchronous design methodology
- Impediments to synchronous design

# 8. Memory, PLDs, CPLDs und FPGAs

- ROM, SRAM, DRAM, SDRAM
- Programmable logic devices (PLDs)
- Complex programmable logic devices (CPLDs)
- Field-programmable gate arrays (FPGAs)

# 9. Microprocessor Technology (Principles)

- Computer history
- Von Neumann architecture
- Components of a microprocessor system

### Literature

- S. Voigt, Skript zur Vorlesung "Technische Informatik"
- J. Wakerly, Digital Design: Principles and Practices, 4. Auflage, 2010, Pearson Prentice Hall, ISBN: 978-0-13-613987-4
- D. Hoffmann, Grundlagen der Technischen Informatik, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9



Module M0853: Mathematics	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 Differential	Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential		Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differential		Recitation Section (large)	1	1
· · · · · ·	Prof. Anusch Taraz			
· · · · · · · · · · · · · · · · · · ·	one			
	Mathematics I + II			
Knowledge				
	fter taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate			
	<ul> <li>Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples.</li> </ul>			3 -4-4 -4-
	Students can discuss logical connections between these	e concepts. They are capable of illustrating	hese connections w	th the help of examples.
	They know proof strategies and can reproduce them.			
Skills				
	Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreove			in this course. Moreover,
	they are capable of solving them by applying established	d methods.		
	Students are able to discover and verify further logical collections.	onnections between the concepts studied in	the course.	
	For a given problem, the students can develop and execution	cute a suitable approach, and are able to crit	ically evaluate the re	sults.
Personal Competence				
Social Competence				
	Students are able to work together in teams. They are capable to use mathematics as a common language.  In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to			
	<ul> <li>In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.</li> </ul>			
	check and deepen the understanding of their peers.			
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 have developed sufficient persistence to be ab	le to work for longer periods in a goal-orient	ed manner on hard	oroblems.
Workload in Hours In	dependent Study Time 128, Study Time in Lecture 112			
Credit points 8	8			
Examination W	Written exam			
Examination duration and scale 60	60 min (Analysis III) + 60 min (Differential Equations 1)			
Assignment for the Following G	General Engineering Science (German program): Core qualification: Compulsory			
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory			
С	Civil- and Environmental Engineering: Core qualification: Compulsory			
Bi	ioprocess Engineering: Core qualification: Compulsory			
С	omputer Science: Core qualification: Compulsory			
E	lectrical Engineering: Core qualification: Compulsory			
E	nergy and Environmental Engineering: Core qualification: Cor	npulsory		
G	eneral Engineering Science (English program): Core qualifica	tion: Compulsory		
G	eneral Engineering Science (English program, 7 semester): C	ore qualification: Compulsory		
С	omputational Science and Engineering: Core qualification: Co	ompulsory		
М	echanical Engineering: Core qualification: Compulsory			
L	echatronics: Core qualification: Compulsory			
IVI				
	aval Architecture: Core qualification: Compulsory			



Course L1028: Analysis III		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	Main features of differential and integrational calculus of several variables	
	Differential calculus for several variables Mean value theorems and Taylor's theorem Maximum and minimum values Implicit functions Minimization under equality constraints Newton's method for multiple variables Double integrals over general regions Line and surface integrals Theorems of Gauß and Stokes	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

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

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

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



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

course L1033: Differential 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	
Fitle	Typ         Hrs/wk         CP           Lecture         2         4
ntroduction to Control Systems (L0654) ntroduction to Control Systems (L0655)	Lecture         2         4           Recitation Section (small)         2         2
Module Responsible	Prof. Herbert Werner
Admission Requirements	none
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second orc</li> <li>systems</li> </ul>
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Chille	
Skills	Students can transform models of linear dynamic systems from time to frequency domain and vice versa
	They can simulate and assess the behavior of systems and control loops
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules
	They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
	They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
Social Competence	
Autonomy	
,	problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	half and the Control Transfer Control Transfer Land and Control Transf
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Credit points Examination	
	6 Written exam
Examination	6 Written exam 120 min
Examination Examination duration and scale	6 Written exam 120 min General Engineering Science (German program): Core qualification: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsor
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsor
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focu
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (Ger
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Gen
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Science  German Program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program; 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering: Core qualification: Compulsory Energy and Environmental
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering. Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productic Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering S
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science; Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsor
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computers: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsor
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  120 min
Examination Examination duration and scale Assignment for the Following	Written exam  120 min  General Engineering Science (German program): Core qualification: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Computers: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsor



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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core qualification: Compulsory

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
	<ul> <li>Linear systems, differential equations and transfer functions</li> <li>First and second order systems, poles and zeros, impulse and step response</li> </ul>
	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 systems
	Smith predictor
	Digital control
	Sampled data systems, difference equations
	Sampled-data systems, difference equations     Tustin approximation, digital implementation of PID controllers
	Tuber approximation, digital implementation of FID controllers
	Software tools
	Introduction to Matlab, Simulink, Control toolbox
	Computer-based exercises throughout the course
Literature	Werner, H., Lecture Notes "Introduction to Control Systems"
	G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009
	K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010



Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
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



## Specialization Civil- and Environmental Engeneering

Module M0740: Structural A	Analysis I			
Courses				
Title	Тур		Hrs/wk	СР
Structural Analysis I (L0666)	Lecture		2	3
Structural Analysis I (L0667)	Recitation Section (large) 2 3			
Module Responsible	Prof. Uwe Starossek			
Admission Requirements				
	none			
	none			
Recommended Previous	Mechanics I, Mathematics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	After successfully completing this module, students can express the basic aspects of linear frame analysis of statically determinate systems.			
Skills	After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are			
	able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.			
Personal Competence				
Social Competence				
Autonomy	The students are able work in-term homework assignments. Due to the in-term feedback	k thay are anabled to calf	f access their learn	ina programa durina
Autonomy	the lecture period, already.	k, they are enabled to sen	-assess their leaft	iing progress during
	and rotate portion, amount			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following			ry	
Curricula	3 11 3 11 (11 11 p 13 11 p 14 11 p 15	eering: Compulsory		
	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and Environmental		у	
	General Engineering Science (English program, 7 semester): Specialisation Civil Engine	eering: Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

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



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



Concrete I			
Concrete i			
	Тур	Hrs/wk	СР
	Seminar	1	2
	Lecture	2	2
	Recitation Section (large)	2	2
Prof. Günter Rombach			
none			
Basic knowledge in structural analysis and building	ng materials.		
After taking part successfully, students have reach	ed the following learning results		
The students can outline the history of concrete	construction and explain the basics of structural engine	eering, including usua	al load combinations a
safety concepts. They are able to draft and dim-	ension simple structures, as well as to evaluate and	discuss the behaviou	r of the materials and
structural members.			
The students are able to apply basic procedure	s of the concention and dimensioning to practical cas	es. They are canable	to draft simple concr
			·
		xeculion. Moreover, ti	iey can make design a
construction sketches and draw up technical desc	inplions.		
The students are able to carry out simple tasks in t	the conception and dimensioning of structures and to cri	tically reflect the resul	ts.
Independent Study Time 110, Study Time in Lectu	ire 70		
6			
Written exam			
120 minutes			
General Engineering Science (German program):	Specialisation Civil- and Environmental Engeneering: Co	ompulsory	
General Engineering Science (German program,	7 semester): Specialisation Civil Engineering: Compulso	ory	
Civil- and Environmental Engineering: Core qualif	fication: Compulsory		
	·		
General Engineering Science (English program):	Specialisation Civil- and Enviromental Engeneering: Co	mpulsory	
	none Basic knowledge in structural analysis and buildir After taking part successfully, students have reach The students can outline the history of concrete safety concepts. They are able to draft and dim structural members.  The students are able to apply basic procedure structures and to design them for bending and be construction sketches and draw up technical descriptions are able to carry out simple tasks in Independent Study Time 110, Study Time in Lecture Written exam 120 minutes General Engineering Science (German program): General Engineering Science (German program)	Typ Seminar Lecture Recitation Section (large)  Prof. Günter Rombach none Basic knowledge in structural analysis and building materials.  After taking part successfully, students have reached the following learning results  The students can outline the history of concrete construction and explain the basics of structural engine safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and structural members.  The students are able to apply basic procedures of the conception and dimensioning to practical cas structures and to design them for bending and bending with axial force, and to plan their detailing and econstruction sketches and draw up technical descriptions.  The students are able to carry out simple tasks in the conception and dimensioning of structures and to critical independent Study Time 110, Study Time in Lecture 70  6  Written exam  120 minutes  General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Colored in the conception of	Typ Hrs/wk Seminar 1 Lecture 2 Recitation Section (large) 2 Prof. Günter Rombach none Basic knowledge in structural analysis and building materials.  After taking part successfully, students have reached the following learning results  The students can outline the history of concrete construction and explain the basics of structural engineering, including usus afety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behavious structural members.  The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, the construction sketches and draw up technical descriptions.  The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the result independent Study Time 110, Study Time in Lecture 70  6  Written exam  120 minutes  General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

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

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



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



	d Systems
Courses	
Title	Typ Hrs/wk CP
Signals and Systems (L0432)	Lecture 3 4
Signals and Systems (L0433)	Recitation Section (large) 1 2
Module Responsible	Prof. Gerhard Bauch
Admission Requirements	None Mathematica 4.0
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 the moduls Mathematik 1-3 is experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are
	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which
	caused by the transition of a continuous-time signal to a discrete-time signal.
Skills	
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can as
	the impact of LTI systems on the signal properties in time and frequency domain.
Personal Competence	The abudants are initially salve are offer well-to-
Social Competence	The students can jointly solve specific problems.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the le
Wester de Herre	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Comput
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Scie Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Mechanical Engineering, Focus Theoretical
	Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compuls
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircrait Systems Engineering: Compusion General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Science (English program): Specialisation Mechanical English (English program): Specialisation Mechanical Engineering Science (English program): Specialisation Mechanical Engineering
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



Module M0706: Geotechnic	sl			
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 have reached	the following learning results		
Professional Competence				
Knowledge	The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, water or structures,			
	consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure.			
Skills	After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of			
	geotechnical standard tests. They can calculate stre	sses and deformation in the soils due to weight or in	nfluence of structures. 7	They are are able to prove
	the usability (settlements) for shallow foundations.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program): S	pecialisation Civil- and Enviromental Engeneering: (	Compulsory	
Curricula	General Engineering Science (German program, 7 s	semester): Specialisation Civil Engineering: Compul-	sory	
	Civil- and Environmental Engineering: Core qualific	ation: Compulsory		
	General Engineering Science (English program): Sp	pecialisation Civil- and Enviromental Engeneering: C	ompulsory	
	General Engineering Science (English program, 7 s	emester): Specialisation Civil Engineering: Compuls	ory	

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



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

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



M. J. J. MO744 Olivertees I	Variable II			
Module M0744: Structural A	Analysis II			
Courses				
Title		Тур	Hrs/wk	СР
Structural Analysis II (L0673)		Lecture	2	3
Structural Analysis II (L0674)		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I/II			
Knowledge	Mathematics I/II			
	Differential Equations I			
	Structural Analysis I			
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	After successful completion of this module, students can exp	ress the basic aspects of linear frame analysis	s of statically indeterm	inate systems.
Chille	After a consection of the constant and t		-+:fl	
Skills	After successful completion of this module, the students are	able to analyze state variables and to constru-	ct influence lines of st	atically inderminate plane
	and spatial frame and truss structures.			
Personal Competence				
Social Competence				
Autonomy	The students are able to work in-term homework assignm	ents. Due to the in-term feedback, they are	enabled to self-asses	s their learning progress
	during the lecture period, already.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialis	ation Civil- and Enviromental Engeneering: Co	ompulsory	
Curricula	General Engineering Science (German program, 7 semeste	r): Specialisation Civil Engineering: Compulso	ory	
	Civil- and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisa	tion Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 semester	): Specialisation Civil Engineering: Compulso	ry	

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



Course L0674: Structural Analysis II		
Тур	Recitation Section (large)	
Hrs/wk	2	
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	



ourses				
/u1003				
tle		Тур	Hrs/wk	CP
troduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	3 2	3
Module Responsible	Prof. Christoph Ihl	Troblem-based Learning	2	3
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many diff Marketing and Innovation, and also to Investment and Controlling. In parti		nagement, from Planr	ning and Organisation
	explain the differences between Economics and Management and	d the sub-disciplines in Manageme	ent and to name impo	ortant definitions from t
	field of Management			
	explain the most important aspects of and goals in Management a			
	describe and explain basic business functions as production, pro- reseauce management information management inposestion management.		chain management, o	organization and hum
	ressource management, information management, innovation man  explain the relevance of planning and decision making in Busin		Itinle objectives and	uncertainty and expla
	some basic methods from mathematical Finance	ooo, oop. III olaaaono anaoi mai	apio objectivos and	anconanty, and oxpin
	state basics from accounting and costing and selected controlling	methods.		
Skills	Students are able to analyse business units with respect to different temperature in a team. In particular, they are able to	ent criteria (organization, object	tives, strategies etc.	) and to carry out
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies     apply methods for decision making under multiple objectives, und.	or upportainty and updor rick		
	<ul> <li>apply methods for decision making under multiple objectives, under analyse production and procurement systems and Business inform</li> </ul>			
	analyse and apply basic methods of marketing	nation systems		
	select and apply basic methods from mathematical finance to pred	lefined problems		
	apply basic methods from accounting, costing and controlling to pre-	redefined problems		
Personal Competence				
Social Competence	Students are able to			
,				
	work successfully in a team of students			
	<ul> <li>to apply their knowledge from the lecture to an entrepreneurship p</li> <li>to communicate appropriately and</li> </ul>	roject and write a conerent report	on the project	
	to confind find a phrophiately 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			
Orean points				
Examination	90 Minuten			
Examination Examination duration and scale		al Engineering: Compulsory		
Examination duration and scale	General Engineering Science (German program): Specialisation Electrica			
	General Engineering Science (German program): Specialisation Electrica General Engineering Science (German program): Specialisation Compute	er ocience. Compuisory		
Examination duration and scale Assignment for the Following				
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Computer	Engineering: Compulsory		
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process	Engineering: Compulsory	ompulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy and General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Engi	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Con		
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Con ical Engineering: Compulsory		
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Biomedi	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Con ical Engineering: Compulsory cal Engineering: Compulsory		
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce (German Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Biomedi General Engineering Science (German program): Specialisation Naval An	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Con ical Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory	npulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Biomedi	Engineering: Compulsory  and Enviromental Engineering: Co  d Enviromental Engeneering: Co  dical Engineering: Compulsory  cal Engineering: Compulsory  rchitecture: Compulsory  tion Electrical Engineering: Comput	npulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy of General Engineering Science (German program): Specialisation Civil-an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Biomedi General Engineering Science (German program): Specialisation Naval Au General Engineering Science (German program, 7 semester): Specialisation	Engineering: Compulsory  and Enviromental Engineering: Co  d Enviromental Engeneering: Co  dical Engineering: Compulsory  cal Engineering: Compulsory  rchitecture: Compulsory  tion Electrical Engineering: Compul  tion Process Engineering: Compul	ulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Biomedi General Engineering Science (German program): Specialisation Naval Al General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Engineering: Compulsory  and Enviromental Engineering: Co  d Enviromental Engeneering: Co  dical Engineering: Compulsory  cal Engineering: Compulsory  rothitecture: Compulsory  tion Electrical Engineering: Compul  tion Process Engineering: Compul  tion Biomedical Engine	ulsory lsory pulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy and General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanic General Engineering Science (German program): Specialisation Biomedit General Engineering Science (German program): Specialisation Naval And General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisatic General Engineering Science (German program, 7 semester): Specialisatic General Engineering Science (German program, 7 semester): Specialisatic	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod ical Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulso	ulsory lsory npulsory ry	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy and General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanic General Engineering Science (German program): Specialisation Biomedic General Engineering Science (German program): Specialisation Naval And General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisatic General Engineering Science (German program)	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod d Enviromental Engeneering: Con dical Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulso tion Computer Science: Compulso	ulsory lsory npulsory rry	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy and General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanica General Engineering Science (German program): Specialisation Mechanica General Engineering Science (German program): Specialisation Naval And General Engineering Science (German program, 7 semester): Specialisation General Engineering S	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod d Enviromental Engeneering: Con dical Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulso tion Computer Science: Compulso tion Bioprocess Engineering: Com tion Civil Engineering: Compulsor tion Civil Engineering: Compulsor	ulsory lsory spulsory spry spry spulsory spulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Naval At General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Co d Enviromental Engeneering: Co d Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulso tion Computer Science: Compulso tion Bioprocess Engineering: Com tion Civil Engineering: Compulsor tion Civil Engineering: Compulsor tion Energy and Enviromental Eng	ulsory lsory pulsory pry pry pulsory y gineering: Compulsory	
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy a General Engineering Science (German program): Specialisation Civil- an General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Mechani General Engineering Science (German program): Specialisation Naval At General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Co d Enviromental Engeneering: Co d Enviromental Engeneering: Co d Engineering: Compulsory cal Engineering: Compulsory rchitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulso tion Computer Science: Compulso tion Bioprocess Engineering: Com tion Civil Engineering: Compulsor tion Energy and Enviromental Eng tion Mechanical Engineering, Focu	ulsory lsory pulsory pry pulsory y pulsory y gineering: Compulsory us Mechatronics: Con	npulsory
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy of General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanican General Engineering Science (German program): Specialisation Mechanican General Engineering Science (German program): Specialisation Naval Acceptate Engineering Science (German program, 7 semester): Specialisation General Engineering Sc	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod d Enviromental Engeneering: Con dical Engineering: Compulsory cal Engineering: Compulsory rehitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulsor tion Computer Science: Compulsor tion Bioprocess Engineering: Compul tion Bioprocess Engineering: Compulsor tion Civil Engineering: Compulsor tion Energy and Enviromental Eng tion Mechanical Engineering, Focu tion Mechanical Engineering	ulsory lsory pulsory pry pulsory pulsory y gineering: Compulsor us Mechatronics: Con us Biomechanics: Con	npulsory mpulsory
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy of General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanic General Engineering Science (German program): Specialisation Mechanic General Engineering Science (German program): Specialisation Naval Arageneral Engineering Science (German program, 7 semester): Specialisation General Engineering Scien	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod d Enviromental Engeneering: Cod d Engineering: Compulsory cal Engineering: Compulsory rehitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulsor tion Computer Science: Compulsor tion Bioprocess Engineering: Compulsor tion Civil Engineering: Compulsor tion Energy and Enviromental Eng tion Mechanical Engineering, Focution Mechanical Engineering	ulsory Isory Isory Ipulsory Inpulsory Inpulsory Inpulsory Inpulsory Inpulsory Isory	npulsory mpulsory ngineering: Compulso
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation Compute General Engineering Science (German program): Specialisation Process General Engineering Science (German program): Specialisation Bioproce General Engineering Science (German program): Specialisation Energy of General Engineering Science (German program): Specialisation Civil- and General Engineering Science (German program): Specialisation Mechanican General Engineering Science (German program): Specialisation Mechanican General Engineering Science (German program): Specialisation Naval Acceptate Engineering Science (German program, 7 semester): Specialisation General Engineering Sc	Engineering: Compulsory ess Engineering: Compulsory and Enviromental Engineering: Cod d Enviromental Engeneering: Cod d Enviromental Engeneering: Cod d Engineering: Compulsory cal Engineering: Compulsory rehitecture: Compulsory tion Electrical Engineering: Compul tion Process Engineering: Compul tion Biomedical Engineering: Compul tion Naval Architecture: Compulsor tion Computer Science: Compulsor tion Bioprocess Engineering: Compulsor tion Civil Engineering: Compulsor tion Energy and Enviromental Eng tion Mechanical Engineering, Focution Mechanical Engineering	ulsory Isory Isory Ipulsory Inpulsory Inpulsory Inpulsory Inpulsory Inpulsory Isory	npulsory mpulsory ngineering: Compulso



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

 $General\ Engineering\ Science\ (English\ program):\ Specialisation\ Bioprocess\ Engineering:\ Compulsory$ 

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program); Specialisation Energy and Environmental Engineering; Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program); Specialisation Process Engineering; Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

 $\label{logistics} \textbf{Logistics and Mobility: Core qualification: Compulsory}$ 

 $\label{thm:mechanical engineering: Core qualification: Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Mana	gement
Typ	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	<ul> <li>Introduction to Business and Management,</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales</li> <li>Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	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.

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



Module M0580: Principles of	of Building Materials and Building Physics				
modulo modoci i imolpioo c	or Building materials and Building 1 myslos				
Courses					
Title		Тур	Hrs/wk	CP	
Building Physics (L0217)		Lecture	2	2	
Building Physics (L0219)					
Building Physics (L0247)					
Principles of Building Materials (L0215)	Lecture 2 2				
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous	Knowledge of physics, chemistry and mathematics from school	I			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results			
Professional Competence					
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe				
	the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes				
	and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection			in the field of protection	
	against moisture, coldness, fire and noise.				
Skills	The students are able to work with the most important standard	lized methods and regularities in the field of r	noisture protection, t	he German regulation for	
	energy saving, fire protection and noise protection in the case of a small building.				
	55 C. T. C.				
Personal Competence					
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge.				
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination	Written exam				
Examination duration and scale	2 stündige Klausur				
Assignment for the Following	General Engineering Science (German program): Specialisation	on Civil- and Enviromental Engeneering: Con	npulsory		
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Civil Engineering: Compulsory	y		
	Civil- and Environmental Engineering: Core qualification: Com	pulsory			
	General Engineering Science (English program): Specialisatio	n Civil- and Enviromental Engeneering: Com	pulsory		
	General Engineering Science (English program, 7 semester): S	Specialisation Civil Engineering: Compulsory	,		
	Technomathematics: Specialisation III. Engineering Science: E				
		F /			

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



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

Course L0215: Principles of Building Materials		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	WiSe	
Content	Structure of building materials	
	Effects of action	
	Fundamentals of mechanical behaviour	
	Principles of metals	
	Joining methods	
	Corrosion	
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3	
	Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8	



Module M0611: Steel Struc	tures I			
00				
Courses		T	Here fords	CP
Title		Typ Lecture	Hrs/wk	
Steel Structures I (L0299) Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Dr. Jürgen Priebe	redication decitor (large)	-	Ü
Admission Requirements	none			
Recommended Previous				
Knowledge	Structural analysis I, Structural analysis II			
Kilowicage	Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	Principles of Building Materials and Building Physics			
Educational Objectives	After taking part successfully, students have reached the follow	ring 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 memers in tension	on, compression and bending		
Skills	Students can rate and apply the material steel appropiately with	th 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 serviceability of	simple members in tension, compression an	d bending.	
Personal Competence				
Social Competence	After participation of an optional course (building of a simple	truss) they are able to organize themselves	in groups. They will	be successful in guided
	building a truss with bolted connections according to design de	rawings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Civil Engineering: Compulsor	у	
	Civil- and Environmental Engineering: Core qualification: Com	ipulsory		
	General Engineering Science (English program): Specialisation	on Civil- and Enviromental Engeneering: Con	npulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Civil Engineering: Compulsor	/	

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



Course L0300: Steel Structures I	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0631: Concrete S	tructures II			
Courses				
Title		Тур	Hrs/wk	CP
Project Concrete Structures II (L0894)		Project Seminar	1	1
Concrete Structures II (L0348)		Lecture	3	4
Concrete Structures II (L0349)		Recitation Section (large)	1	1
Module Responsible	Prof. Günter Rombach			
Admission Requirements	none			
Recommended Previous	- Keep lades of hade an about many describes of a disco			
Knowledge	Knowledge of loads on structures and combination of actions			
	Basics of safety format are required.			
	Knowledge in design of beams and columns for ultimate limit state			
	Lecture 'Concrete Structures I'			
Educational Objections	After telice and according to the depth beauty and the fellowing larger			
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students know the basic principles which arev required for design of	reinforced concrete structures. T	hey know the various	methods to estimate the
	member forces in simple one and two-way slabs.			
Skills	The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack).			
	and deflection control) including detailing (anchorage and links etc.).			
	The students can estimate the member forces of simple slabs.			
	The students know the content and the layout of a structural analys	sis		
	The diagona line is all and it is a factor a diagonal analysis			
Personal Competence				
Social Competence	Cooperation in a project work, where they design in a team a real concrete	e building and present the results	at the end.	
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and	d Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Specialisat	tion Civil Engineering: Elective Co	ompulsory	
	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	d Enviromental Engeneering: Cor	mpulsory	
	General Engineering Science (English program, 7 semester): Specialisati			
	J J ( J - p - J - ,	3 22 3 300000	1 /	

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



Course L0348: Concrete Structures	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Design of concrete members for shear, punching and torsion</li> <li>Design for serviceability limit state (durability): crack- and deflection control</li> <li>Detailing</li> <li>Introduction in the design of plates</li> <li>Layout and content of a structural design</li> </ul>
	<ul> <li>Vorlesungsumdrucke</li> <li>König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010</li> <li>Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011</li> <li>Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997</li> <li>Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 1: Allgemeine Bemessungsregeln für den Hochbau.</li> </ul>

Course L0349: Concrete Structures II	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0755: Geotechnic	s II			
Courses				
Title		Тур	Hrs/wk	СР
Foundation Engineering (L0552)		Lecture	2	2
Foundation Engineering (L0553)		Recitation Section (large)	2	2
Foundation Engineering (L1494)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Modules:			
Knowledge				
	Mechanics I-II			
	Geotechnics I			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students know the basic principles and methods which are required to verificate the stability of geotechnical structures.			
Skills	After successful completion of the module the students are able to:			
	verificate the stability and usability of foundations,			
	venicate the stability and usability or loundations,     know individual methods of ground improvement and apply them in their range of application,			
	design retaining walls.	a apply them in their range of application,		
	design retaining wans.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialis	sation Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semest	er): Specialisation Civil Engineering: Elective Co	mpulsory	
	Civil- and Environmental Engineering: Core qualification: C	Compulsory		
	General Engineering Science (English program): Specialis	ation Civil- and Enviromental Engeneering: Cor	npulsory	
	General Engineering Science (English program, 7 semeste	er): Specialisation Civil Engineering: Elective Co	mpulsory	

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

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



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



Module M0728: Hydraulic E	ingineering I			
Courses				
Title		Тур	Hrs/wk	CP
Hydrology (L0909)		Lecture	1	1
Hydrology (L0956)		Problem-based Learning	1	2
Hydromechanics (L0615)		Lecture	2	2
Hydromechanics (L0616)		Recitation Section (large)	1	1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Mathematics I, II and III			
Knowledge	Mechanik I und II			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulation 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. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological and hydrodynamic values can be described and the students are able to perform analyze and assess respective measurements.			
Personal Competence Social Competence	The students are able to prepare and present technical present	ations for given topics in groups.		
Autonomy	Students can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 2 hours. The examination calculations tasks.	includes tasks with respect to the gene	eral understanding of	the lecture contents and
Assignment for the Following	General Engineering Science (German program): Specialisation	n Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	General Engineering Science (German program, 7 semester): S	Specialisation Civil Engineering: Compulso	ory	
	Civil- and Environmental Engineering: Core qualification: Comp	pulsory		
	General Engineering Science (English program): Specialisation	n Civil- and Enviromental Engeneering: Co	ompulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Civil Engineering: Compulso	ry	

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:
	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 L0956: Hydrology		
Тур	Problem-based Learning	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
	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: Hydromechanics	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Fundamentals of Hydromechanics
	Characteristics of fluids Hydrostatics Kinematics of flows, laminar and turbulent flows Conservation laws Conservation of mass Conservation of Energy Momentum Equation Application of conservation laws to flow conditions
Literature	Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2
	E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ hydraulik_tool/index.html)
	Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998.
	Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.

Course L0616: Hydromechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0869: Hydraulic E	naincorina II			
Module Mooos: Hydraulic E	ingineering ii			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L0959)		Lecture	2	2
Hydraulic Engineering (L0960)		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Hydraulik Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic			
	formulations (conservation laws) to practical hydraulic	engineering problems. Besides this, the studer	nts can illustrate imp	ortant tasks of hydrauli
	engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.			
Skills				
	systems. Besides this, they are able to use and apply established approaches of hydraulics and determine water surfaces of channel flows, influences of			
	constructions (weirs, etc.) on channel flows as well as flo	ow conditions of pipe system.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionally, they will be able to work in team with engineers of other			
	disciplines.			
Autonomy	The students will be able to independently extend their l	knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 2 hours. The exam	nination includes tasks with respect to the gener	ral understanding of	the lecture contents and
	calculations tasks.			
Assignment for the Following	General Engineering Science (German program): Speci	alisation Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Civil Engineering: Elective C	ompulsory	
	Civil- and Environmental Engineering: Core qualification	n: Compulsory		
	General Engineering Science (English program): Specia	alisation Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Civil Engineering: Elective Co	ompulsory	

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

Course L0958: Hydraulics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

Course L0960: Hydraulic Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0686: Sanitary En	gineering			
Courses				
Title Wastewater Disposal (L0276)		Typ Lecture	Hrs/wk	<b>CP</b> 2
Wastewater Disposal (L0278)		Recitation Section (large)	1	1
Drinking Water Supply (L0306)	Lecture 2 1			
Drinking Water Supply (L0308)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	none			
Recommended Previous	Basic knowledge on Chemistry and Biology			
Knowledge	Hydraulics of pipe systems and open channels			
	Basic knowledge on water management: water quantity and water of	quality		
	Basic knowledge on Environmental Legislation: Federal Water Act			
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastru			
	standards for the design of drinking water supply and wastewater dispo			
	empiricals assumptions and scientific simplifications. The students are able			-
	used for drinking and wastewater treatment. They can also assess existin	• •		
	saftey aspects. Furthermore, they know how to draft the features and ef		s of the future su	ch as high- and low-
	pressure membrane filtration systems and techniques for the removal of tra	ce pollutants.		
Skills	The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence				
Social Competence	Students are able to form concepts on their own to optimize urban water	infrastructure processes. Therefore th	nev can acquire a	opropriate knowledge
Social Compotence	when being given some clues or information with regard to the approach to	•		spirate anomicage
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and		-	
Curricula	General Engineering Science (German program, 7 semester): Specialisation	on Civil Engineering: Elective Compuls	sory	
	Civil- and Environmental Engineering: Core qualification: Compulsory	Furthermortal France (1. C		
	General Engineering Science (English program): Specialisation Civil- and		•	
	General Engineering Science (English program, 7 semester): Specialisatio	n Civil Engineering: Elective Compuls	ory	



Course L0276: Wastewater Disposa		
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, Membrane Filtration)	
	Biological Treatment (aerobic, anaerobic, anoxic)	
	Special Wastewater Treatment Processes (Ozonation, Adsorption)	
Literature	Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.	
	The literature listed below is available in the library of the TUHH.	
	Taschenbuch der Stadtentwässerung : mit 10 Tafeln und 67 Tabellen, Imhoff, K., & . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl.	
	<ul> <li>Abwasser: Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998.</li> <li>Kommunale Kläranlagen: Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Gunthert, F. Wolfgang: (3., vollig neu bearb. Aufl.).</li> </ul>	
	• Rominiumale Naramagen: Bernessung, Erweiterung, Optimierung, Berneb und Rosten, (2009). Guntnert, F. Wollgang: (3., Vollig neu bearb. Auli.).  Renningen: expert-Verl.	
	• Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.	
	Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.	
	Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.	

Course L0278: 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	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



## **Specialization Energy and Environmental Engineering**

Forms of energy are used in a variety of ways in industry, domestic households and transportation, so energy is now as important a part of our daily lives as water. Increasingly, attention is paid to sustainable use of energy, without imposing long-term strains on coming generations. Cross-linked training in the foundations of and current issues around energy technology takes account of this situation. One increasingly important concern is to reduce CO<sub>2</sub> emissions responsible for the greenhouse effect. In pursuit of this, energy-saving opportunities are pursued and increasing use is made of regenerative energies. Though fossil fuels will still have to be used for a long time to come, efforts are made to reduce CO<sub>2</sub> emissions by increasing efficiency and by capturing the CO<sub>2</sub> their use generates and storing it underground. These processes in particular make it essential for energy engineering and environmental engineering activities to be closely linked.

	and differential disgricoring data floor to be disoutly limited.					
Module M0598: Mechanica	l Engineering: Design					
Courses						
Title		Тур	Hrs/wk	CP		
Embodiment Design and 3D-CAD (L0268)		Lecture	2	1		
Mechanical Design Project I (L0695)		Practical Course	3	2		
Mechanical Design Project II (L0592)		Practical Course	3	2		
Team Project Design Methodology (L0267		Problem-based Learning	2	1		
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous	Fundamentals of Mechanical Engineering Design					
Knowledge	Mechanics					
	Fundamentals of Materials Science					
	Production Engineering					
Educational Objectives	After taking part successfully, students have reached the following learning	ng results				
Professional Competence						
Knowledge	After passing the module, students are able to:					
	eyplain design quidelines for machinery parte o a considering les	ad situation, materials and many	acturing requirements			
	<ul> <li>explain design guidelines for machinery parts e.g. considering los</li> <li>describe basics of 3D CAD,</li> </ul>	iu silualion, malendis anu illanu	actaining requirements			
	explain basics methods of engineering designing.					
	- Oxpiani pasios metrous or engineering designing.					
Skills	After passing the module, students are able to:					
		intinue a maine OD CAD				
	independently create sketches, technical drawings and document	ations e.g. using 3D CAD,				
	design components based on design guidelines autonomously,					
	dimension (calculate) used components,					
	use methods to design and solve engineering design tasks systam	nucally and solution-oriented,				
	apply creativity techniques in teams.					
Personal Competence						
Social Competence	After passing the module, students are able to:					
	develop and evaluate solutions in groups including making and d	ocumenting decisions,				
	moderate the use of scientific methods,					
	present and discuss solutions and technical drawings within ground and technical drawings.	ps,				
	reflect the own results in the work groups of the course.					
Autonomy	Students are able					
,						
	to estimate their level of knowledge using activating methods wit	hin the lectures (e.g. with clickers	s),			
	To solve engineering design tasks systematically.					
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140					
	6					
Credit points						
Examination	Written exam					
Examination duration and scale	180	outening the total	D			
Assignment for the Following	General Engineering Science (German program): Specialisation Energy	-	ompulsory			
Curricula	General Engineering Science (German program): Specialisation Mechan					
	General Engineering Science (German program): Specialisation Biomed	0 0 1 7	mnulaar:			
	General Engineering Science (German program, 7 semester): Specialisa	0 0				
	General Engineering Science (German program, 7 semester): Specialisa General Engineering Science (German program, 7 semester): Specialisa					
		uon Energy and Environmental El	igineering. Compuisor	у		
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Energy a	and Environmental Engineering: C	compulsory			
	General Engineering Science (English program): Specialisation Energy &		отпривот у			
	General Engineering Science (English program): Specialisation Mechanical Engineering Science (English program): Specialisation Biomedi					
	General Engineering Science (English program, 7 semester): Specialisation Biomedi General Engineering Science (English program, 7 semester): Specialisation		mnuleory			
	General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Specialisat					
	General Engineering Science (English program, 7 semester): Specialisating General Engineering Science (English program, 7 semester): Specialisating Science (English program): Specialisating Science (English pro			,		
	Mechanical Engineering: Core qualification: Compulsory	ion Energy and Environmental En	gmaamig. Compuisor)	,		
	Mechatronics: Core qualification: Compulsory					
	Naval Architecture: Core qualification: Compulsory					



Course L0268: Embodiment 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	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>	

Course L0695: Mechanical Design Project I				
Тур	Practical Course			
Hrs/wk	3			
СР	2			
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42			
Lecturer	Prof. Thorsten Schüppstuhl			
Language	DE			
Cycle	WiSe			
Content	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	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>			



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

Course L0267: Team Project Design Methodology			
Тур	Problem-based Learning		
Hrs/wk			
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	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-Ill; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Module M0957: Introduction	n into Energy and Environmental Engine	ering		
Courses				
Title		Tun	Hrs/wl	CP
Introduction to Energy and Environmental	Engineering (L0212)	Typ Problem-based Learni		3
Physics-Lab for VT/ BVT/ EUT (L0947)		Laboratory Course	2	3
Module Responsible	Prof. Alfons Kather	•		
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 sketch the different options for electric		-	• • • • • • • • • • • • • • • • • • • •
	level they are able to present and discuss the techn		-	
	affordable energy usage and minimization of environ	. ,	•	the dimension of their future
	responsibility and know about the necessity to find comp	romises between energy usage and env	vironment protection.	
	Through a practical course in physics the students learn	to deliver an overview of specialist aspe	cts of physics.	
Skills	The students master the fundamentals of technical comments		cialized topics orally. By	comparing analysis of literature
	sources, students are able to work scientifically to critically discuss them on a basic level.			
	The students are able to communicate their deepened p	hysics knowledge in ways of written tech	inical communication.	
Personal Competence				
Social Competence	The social skills of the students within the group but also	with the visited Company are strengthe	ned. For the preparation	of the Seminar presentation the
	students learn communication.			
	The practical course in Physics is also carried out in g	roups, including the preparation of the	test reports. The students	s strengthen further their social
	skills, can achieve in group common results and report t	nem in joint protocols.		
Autonomy	In the seminar the students learn individually to formula	e conclusions realistically representing	the praxis. The students	are able to work independently
	on specific technical subjects and to present these to the	group.		
	The students are able to familiarize themselves with exp	erimental demonstrations and individual	ly prepare and present a	short experimental report.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Presentation			
Examination duration and scale	EEUT: Compulsory attendance and seminar incl. discu	ssion; Physics Lab: error calculation se	eminar; 6 Experiments w	ith: introd. seminar (20 min), 4
	handwritten pages preparatory script, transcript on their	· •	•	, , , , ,
Assignment for the Following	General Engineering Science (German program): Speci	alisation Energy and Enviromental Engir	neering: Compulsory	
Curricula	Energy and Environmental Engineering: Core qualificati	**	, ,	
	General Engineering Science (English program): Specia		eering: Compulsory	
	2 2 , 3 , 5 , 7 , 1		- ' '	

Course L0212: Introduction to Energ	gy and Environmental Engineering			
Тур	Problem-based Learning			
Hrs/wk	•			
CP	3			
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Lecturer	Prof. Alfons Kather			
Language	DE			
Cycle	WiSe			
Content	The course is made up of three components: Lectures by invited speakers, excursions and talks by the students. The lectures by invited speakers are			
	connected to the companys where the excursions take place. From the results of the excursions the students prepare their talks under supervision from			
	faculty staff. The talks are presented to the group and discussed.			
	Some sample topics are:			
	Conventional steam power plants and combined cycle power plants			
	<ul> <li>Power plant components (boiler, steam turbine, condenser, feed water heaters, etc.)</li> </ul>			
	Distributed electricity generation and energy supply			
	District and neighbourhood heating networks			
	Renewable energy			
	Energy storage			
	Electric grids			
	Energy management at end-user level			
	Energy-intensive industries			
	Environmental technology (e.g., wastewater treatment plants)			
Literature	Keine erforderlich			



Course L0947: Physics-Lab for VT/	BVT/ EUT
Тур	Laboratory Course
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hansen
Language	DE/EN
Cycle	WiSe
Content	In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and
	optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in
	the course "Physics for TUHH-VT Engineers".
	Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of
	physical equipment, analysis of the results and preparation of a report on the experimental data. The students receive instructions in terms of scientific
	writing as well as feedback on their own reports and level of scientific writing.
	Before every experiment an colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice
	with the corresponding experiment.
Literature	Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.
	Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung "Physik für TUHH-VT Ingenieure" angegebene Literatur gut geeignet ist.



Module M0536: Fundamen	als of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (L0091)		Lecture	2	4
Fluid Mechanics for Process Engineering		Recitation Section (large)	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematics I+II+III			
	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	Simplification and solving of partial differential equation	IS		
	<ul><li>Integration</li></ul>			
Educational Objectives	After taking part successfully, students have reached the follow	ing 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 Reyno			
	<ul> <li>explain simplifications of the Continuity- and Navier-Sto</li> </ul>	skes-Equation by using physical boundary c	onditions	
Skills	The students are able to			
	december of the second			
	describe and model incompressible flows mathematica			
	reduce the governing equations of fluid mechanics by s	·	ns e.g. by integration	
	notice the dependency between theory and technical a			
	use the learned basics for fluid dynamical applications	in fields of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from subject related,     able to work together an subject related tasks in small.			
<ul> <li>able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. exercises)</li> </ul>			i (e.g. duiling sinali git	
	<ul> <li>are able to work out solutions for exercises by themselven</li> </ul>	res, to discuss the solutions orally and to pre	sent the results.	
		,,,,,		
Autonomy	The students are able to			
	search further literature for each topic and to expand the	eir knowledge with this literature		
	work on their exercises by their own and to evaluate the			
	work on their exercises by their evin and to evaluate the	and adda. Wiemedge Mar are leedbask		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	on Energy and Enviromental Engineering: C	ompulsory	
	$\label{thm:continuous} General\ Engineering\ Science\ (German\ program,\ 7\ semester):$	Specialisation Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Energy and Enviromental En	gineering: Compulso	У
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	, ,		
	General Engineering Science (English program): Specialisatio			
	General Engineering Science (English program): Specialisatio	0,	ompulsory	
	General Engineering Science (English program): Specialisatio	0 0 1 ,	la a m	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):		ıneering: Compulsor	у
	Technomathematics: Specialisation III. Engineering Science: E	lective Compuisory		
	Process Engineering: Core qualification: Compulsory			



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

Course L0092: Fluid Mechanics for	Titless Eighteeting
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed
	with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct
	solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-
	frame in small groups and discuss the solutions afterwards.
Literature	4. Orango O T. Farinassina Build masharina Willow New York 2000
	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> </ol>
	2. Durst, F., Stromangsmedianik. Elimining in the Theorie der Stromangen von Fluiden. Springer-Verlag, Berlin, Reidelberg, 2006.  3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
	<ol> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> </ol>
	<ol> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> </ol>
	6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
	<ol> <li>Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> </ol>
	8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
	<ol> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008</li> </ol>
	10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
	11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
	12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011



Module M0610: Electrical M	lachines			
•				
Courses				
Title		Тур	Hrs/wk	CP
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)	T	Recitation Section (large)	2	2
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none	***		
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals, d	ifferentials		
Knowledge	Basics of electrical engineering and mechanical engineering			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principles of electric an	d magnetic fields.		
	They can describe the function of the standard types of electric	machines and present the correspo	nding equations and ch	naracteristic curves. For
	typically used drives they can explain the major parameters of the e	·		
Skills		tic fields in particular ferromagnetic c	ircuits with air gap. For	this they apply the usua
	methods of the design auf electric machines.			
	They can calulate the operational performance of electric machines	from their given characteristic data a	nd selected quantities a	nd characteristic curves
	They apply the usual equivalent circuits and graphical methods.			
Personal Competence				
Social Competence				
Autonomy				
	performance of electric machines from the charactersitic data and the	eycan calculate thereof selected qua	ntities and characteristic	curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Er	ergy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation Me	echanical Engineering: Elective Comp	oulsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Energy and Enviromental E	ngineering: Compulsory	/
	General Engineering Science (German program, 7 semester): Spec	ialisation Mechanical Engineering: E	lective Compulsory	
	Electrical Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En	ergy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program): Specialisation Me	chanical Engineering: Elective Comp	ulsory	
	General Engineering Science (English program, 7 semester): Spec	alisation Energy and Enviromental E	ngineering: Compulsory	
	General Engineering Science (English program, 7 semester): Spec	alisation Mechanical Engineering: El	ective Compulsory	
	Computational Science and Engineering: Specialisation Engineering	ng Sciences: Elective Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Elective	Compulsory		
	Mechanical Engineering: Core qualification: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory			



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

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



Module M0618: Renewable	s and Energy Systems			
Courses				
Title		Тур	Hrs/wk	CP
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Industry (L0)	315)	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 reached the follow	ring learning results		
Professional Competence				
Knowledge	With completion of this module, the students can provide an	overview of characteristics of energy syst	ems and their econd	mic efficiency. They can
	explain the issues occurring in this context. Furthermore, they	can explain details of power generation, po	wer distribution and	power trading wih regard
	to subject-related contexts. The students can explain these as	pects, which are applicable to many energy	systems in general,	especially for renewable
	energy systems and critical discuss them. Furthermore, the stu	dents can explain the environmental benefit	s from the use of such	systems.
Skills	Students are able to apply methodologies for detailed deter	mination of energy demand or energy pro	duction for various t	ypes of energy systems.
	Furthermore, they can evaluate energy systems technically	, environmentally and economically and	design them under	certain given conditions.
	Therefore, they can choose the necessary subject-specific calc		-	
	The students are able to explain questions and possible appr	oaches to its processing from the field of re	newable energies or	ally and to put them them
	into the right context.			
Personal Competence				
·	The shadowte our objects and in a site blade state of a literature			
Social Competence	The students are able to analyze suitable technical altern			ecological chiena under
	sustainability aspects. This allows them to make an effective or	ontribultion to a more sustainable power sup	pıy.	
Autonomy	Students can independently exploit sources, acquire the partic	cular knowledge about the subject area and	transform it to new qu	iestions.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Energy and Enviromental Engineering: C	ompulsory	
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Energy and Environmental En	gineering: Compulso	ry
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering, Foo	cus Energy Systems:	Elective Compulsory
	Energy and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisation	n Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (English program, 7 semester):	**		y
	General Engineering Science (English program, 7 semester):			
<u> </u>	5 5 ( 5 p s g s , s enteres), s		3, -,	, ,

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, Dr. Andreas Wiese
Language	DE
Cycle	SoSe
Content	<ul> <li>Electrical energy in the energy system</li> <li>Demand and use of electrical energy (households, industry, "new" buyers (including e-mobility))</li> <li>Electricity generation         <ul> <li>electricity generation technologies using fossil fuels and their characteristics</li> <li>combined heat and power technologies and their production characteristics</li> <li>electricity generation from renewable energy technologies and their characteristics</li> </ul> </li> <li>Power distribution         <ul> <li>"classic" distribution of electrical energy</li> <li>challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading)</li> </ul> </li> <li>District heating industry</li> <li>Legal and administrative aspects         <ul> <li>Energy Act</li> <li>support instruments for renewable energy</li> <li>CHP Act</li> </ul> </li> <li>Cost and efficiency calculation</li> </ul>
Literature	Folien der Vorlesung



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

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

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	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
Literature	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	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



courses				
itle		Тур	Hrs/wk	CP
troduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	3	3
Module Responsible	Prof. Christoph Ihl	Troblem-based Learning		
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many d Marketing and Innovation, and also to Investment and Controlling. In par		nagement, from Plan	ning and Organisation
	explain the differences between Economics and Management at	nd the sub-disciplines in Managem	nent and to name impo	ortant definitions from t
	field of Management			
	explain the most important aspects of and goals in Management			
	<ul> <li>describe and explain basic business functions as production, pressource management, information management, innovation management.</li> </ul>		chain management,	organization and hum
	explain the relevance of planning and decision making in Bus		ultiple objectives and	uncertainty and expl:
	some basic methods from mathematical Finance	mood, oop. m ondadono andor me	p.o objectives and	and oxpi
	state basics from accounting and costing and selected controlling	g methods.		
Skills	Students are able to analyse business units with respect to diffe Entrepreneurship project in a team. In particular, they are able to	erent criteria (organization, object	ctives, strategies etc	.) and to carry out
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies     apply methods for decision making under multiple objectives, un	der uncertainty and under rick		
	<ul> <li>apply methods for decision making under multiple objectives, un</li> <li>analyse production and procurement systems and Business info</li> </ul>			
	analyse and apply basic methods of marketing	mater systems		
	select and apply basic methods from mathematical finance to pre	edefined 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			
	<ul> <li>to apply their knowledge from the lecture to an entrepreneurship</li> <li>to communicate appropriately and</li> </ul>	project and write a conerent repor	t 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.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Electric	cal Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Compu			
	General Engineering Science (German program): Specialisation Proces	s Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biopro	cess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy	and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program): Specialisation Civil- a		mpulsory	
	General Engineering Science (German program): Specialisation Mecha			
	General Engineering Science (German program): Specialisation Biomed General Engineering Science (German program): Specialisation Naval			
	General Engineering Science (German program, 7 semester): Specialis	• •	pulsory	
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis		-	
	General Engineering Science (German program, 7 semester): Specialis	ation Naval Architecture: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialis	ation Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialis	ation Bioprocess Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis General Engineering Science (German program, 7 semester): Spec		•	
	Compulsory	ansation wednamear Engineering	g, rocus ivialeriais If	Engineering Science
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering	, Focus Theoretical N	Mechanical Engineeri



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program); Specialisation Energy and Environmental Engineering; Compulsory

 $\label{thm:computer} \textbf{General Engineering Science (English program): Specialisation Computer Science: Compulsory}$ 

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

 $\label{thm:mechanical engineering:Core qualification:Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture			
Hrs/wk	3			
CP	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfga			
Lecturer	or. Omstoph in, Prof. Moster Becker, Prof. Omstan Lutije, Prof. Omstan Angle, Prof. Kathin Pischer, Prof. Coments Aerstat, Prof. wongan Prsten, Prof. Matthias Meyer, Prof. Thomas Wrona			
Language	DE			
Cycle	WiSe/SoSe			
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales</li> <li>Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> </ul>			
Literature	<ul> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul> Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008			
Literature				
	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.			
	$\mathbf{I}$			

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



	ent Technology for Mechanical and Process En			
Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Control	rol Systems (L1119)	Laboratory Course	2	2
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3
Measurement Technology for Mechanical and Process Engineers (L1118)  Recitation Section (large)  1 1				
Module Responsible	Dr. Sven Krause			
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering	ng		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundmentals of	the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static a
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for dif	forant kinds of quantities to be massured	(Floatrical Quantities	Fomporaturo mochani
	quantities, Flow, Time, Frequency).	leterit killus of quantities to be maesured	(Liectical Quantities,	remperature, mechani
	quantities, flow, fille, frequency).			
	They can describe important methods of chemical Analysis (Ga	s Sensors, Spectroscopy, Gas Chromatog	raphy)	
Skills	Students can select suitable measuring methods to given proble	ems and can use refering measurement de	evices in practice.	
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues in			
	the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and document the	m in a common report.		
	2.2.2. 2 2 2 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.			
Autonomy	Students are able to familiarize themselves with new measuren	nent technologies.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisatio		Compulsory	
Curricula	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (English program): Specialisation Riomedical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): S	•		,
	General Engineering Science (English program, 7 semester): S			
	General Engineering Science (English program, 7 semester): S			
	Mechanical Engineering: Core qualification: Compulsory	pos.aoation i roocos Engineening. Comp	u,	
	Mechatronics: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory			



	Laboratory Course
, ,	Laboratory Course
Hrs/wk	2
CP	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Wolfgang Schröder
. 33.	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants 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	Versuch 1:
	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftlich Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münche Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren     Ginutationen and in the Asynchronmotoren
	<ul> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> </ul>
	<ul> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	Versuch 4:
	<ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



Course L1116: Measurement Technology for Mechanical and Process Engineers		
	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Sven Krause DE	
Language	WiSe WiSe	
Content	1 Fundamentals	
	1.1 Quantities and Units	
	1.2 Uncertainty	
	1.3 Calibration	
	1.4 Static and Dynamic Properties of Sensors and Systems	
	2 Measurement of Electrical Quantities	
	2.1 Current and Voltage	
	2.2 Impedance	
	2.3 Amplification	
	2.4 Oscilloscope	
	2.5 Analog-to-Digital Conversion	
	2.6 Data Transmission	
	3 Measurement of Nonelectric Quantities	
	3.1 Temperature	
	3.2 Length, Displacement, Angle	
	3.3 Strain, Force, Pressure	
	3.4 Flow	
	3.5 Time, Frequency	
	4 Chemical Analysis	
	4.1 Gas Sensors	
	4.2 Spectroscopy	
	4.3 Gas Chromatography	
	At the end of each lecture students present single measuring techniques and results orally in front of the class.	
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 and Process Engineers		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1275: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technol	ogy (L1387)	Laboratory Course	1	1
Environmental Technologie (L0326)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound k	nowledge of environmental technological	ogy. They are able to de	escribe the behaviour of
	chemicals in the environment. Students can give an overview of	scientific disciplines involved. They	can explain terms and	allocate them to related
	methods.			
Skille	Students are able to propose appropriate management and mitiga	tion massures for anyironmental are	blome Thoy are able to	dotormino googhomical
Skills	parameters and to assess the potential of pollutants to migrate			
	Environmental Technology contributes to sustainable development			·
	Environmental resimology contributes to sustainable development	, and may our present and delend in	osc opinions in noncora	na agamst the group.
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop differen			able to develop different
	approaches to the task as a group as well as to discuss their theore	tical or practical implementation.		
Autonomy	Students can independently exploit sources about of the subject, ac	equire the particular knowledge and t	ranfer it to new problems	S.
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisation Er	nergy and Enviromental Engineering	: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Pr	ocess Engineering: Elective Compul	sory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviromental	Engineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Spec	cialisation Process Engineering: Elec	tive Compulsory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Bioprocess Engineering: E	lective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En	**		
	General Engineering Science (English program): Specialisation Program			
	General Engineering Science (English program, 7 semester): Spec	••		′
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec	ialisation Bioprocess Engineering: E	lective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory			

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



Course L0326: Environmental Technologie		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)	



Module M0538: Heat and N	lass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are capable of explaining qualitative	tive and determining quantitative heat transfer in	procedural apparati	us (e. g. heat exchange
	chemical reactors).			
	They are capable of distinguish and characterize	e different kinds of heat transfer mechanisms name	ly heat conduction,	heat transfer and therm
	radiation.			
	The students have the ability to explain the phys	ical basis for mass transfer in detail and to describe	e mass transfer qual	itative and quantitative
	using suitable mass transfer theories.			
	They are able to depict the analogy between hea	it- and mass transfer and to describe complex linker	d processes in detai	l.
Skills				
	The students are able to set reasonable system     The students are able to set reasonable system     The students are able to set reasonable system		ig the gained knowl	edge and to balance it
	<ul> <li>corresponding energy and mass flow, respective</li> <li>They are capable to solve specific heat transfer</li> </ul>		ature alteration in flu	ide) and to calculate t
	corresponding heat flows.	problems (e.g. neated chemical reactors, tempera	ature atteration in it	ilus) and to calculate t
	<ul> <li>Using dimensionless quantities, the students can</li> </ul>	execute scaling up of technical processes or appa	ratus	
	They are able to distinguish between diffusion,			vledge for the description
	and design of apparatus (e.g. extraction column,		y can ase ans anov	ricage for the accompan
	In this context, the students are capable to ch		d mass exchanger	for a specific application
	considering their advantages and disadvantages			
	In addition, they can calculate both, steady-state		aratus.	
		owledge obtained in this course with knowlegde		In particular the cours
	thermodynamics, fluid mechanics and chemical p	process engineering) to solve concrete technical pro-	oblems.	
Personal Competence				
Social Competence	The students are capable to work on subject-spe	poific challenges in teams and to present the result	e orally in a reason	able manner to tutore a
	other students.	echic challenges in learns and to present the result	s orally iii a reasona	able manner to tutors at
	other students.			
A . (				
Autonomy	The students are able to find and evaluate neces	sary information from suitable sources		
	They are able to prove their level of knowled	ge during the course with accompanying proced	dure continuously (	clicker-system, exam-li
	assignments) and on this basis they can control t	heir learning processes.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination				
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specia	alisation Process Engineering: Compulsory		
Curricula				
	General Engineering Science (German program): Specia	alisation Energy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 seme	ester): Specialisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 seme		•	
	General Engineering Science (German program, 7 seme	ester): Specialisation Energy and Enviromental Eng	ineering: Compulso	ry
	Bioprocess Engineering: Core qualification: Compulsory	,		
	Energy and Environmental Engineering: Core qualificati	on: Compulsory		
	General Engineering Science (English program): Specia	alisation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specia	alisation Energy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (English program): Specia	alisation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Specialisation Process Engineering: Compul	sory	
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory				
	General Engineering Science (English program, 7 seme		ineering: Compulsor	у
	Technomathematics: Specialisation III. Engineering Scientific Scie			
	Technomathematics: Core qualification: Elective Compu	lsory		
	Process Engineering: Core qualification: Compulsory			

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

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	



Module M0546: Thermal Se	paration Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	2	2
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory 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 I	parning regulte		
,	After taking part successiony, students have reached the following in	earning results		
Professional Competence				
Knowledge	The students can distinguish and describe different types of	separation processes such as distillation	, extraction, and ad	sorption
	The students develop an understanding for the course of cours	oncentration during a separation proces	s, the estimation of	the energy demand of a
	process, the possibilities of energy saving, and the selection	of separation systems		
	<ul> <li>They have good knowledge of designing methods for separ</li> </ul>	ation processes and devices		
Skills	Using the gained knowledge the students can select a reasi	onable system boundary for a given seps	aration process and	can close the associated
	energy and material balances	briable system boundary for a given sepa	iration process and	can close the associated
	The students can use different graphical methods for the des	signing of a senaration process and defin	ie the amount of the	oretical stages required
	They can select and design a basic type of thermal separ			
	process	ation process for a given case based o	ii iile advantages e	ina disadvantages of the
	The students are capable to obtain independently the needs	ad material properties from appropriate s	ources (diagrams a	nd tables)
	The state its are capable to obtain independently the needs     They can calculate continuous and discontinuous processes.		ources (diagrams ar	id tables)
	They can calculate continuous and discontinuous processes.     The students are able to prove their theoretical knowledge in			
	The students are able to discuss the theoretical background	·	with the teachers in	a colloquium
	- The stadents are able to discuss the theoretical background	and the content of the experimental work	With the teachers in	roonoquiani.
	The students are capable of linking their gained knowledge with the	e content of other lectures and use it tog	gether for the solution	on of technical problems.
	Other lectures such as thermodynamics, fluid mechanics and chem	cal engineering.		
Personal Competence				
Social Competence				
	The students can work technical assignments in small group	is and present the combined results in the	e tutorial	
	The students are able to some out are stical lab want in case	II and the second arranging a firmational division		a than Than are able to
	The students are able to carry out practical lab work in small translations the students are able to carry out practical lab work in small translations.		sion of labor betwee	in them. They are able to
	discuss their results and to document them scientifically in a	report.		
Autonomy				
,	The students are capable to obtain the needed information f	rom suitable sources by themselves and	assess their quality	
	The students can proof the state of their knowledge with exa	m resembling assignments and in this wa	ay control their learr	ning process
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			<u> </u>
Credit points	6		· · · · · · · · · · · · · · · · · · ·	
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation Pr	ocess Engineering; Compulsory		
Curricula	General Engineering Science (German program): Specialisation Fi			
Carricula	General Engineering Science (German program): Specialisation Er		mpulsory	
	General Engineering Science (German program, 7 semester): Specialisation En			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec		•	v
	Bioprocess Engineering: Core qualification: Compulsory	and Livionendi Eligi	nooning. Compulso	,
	Energy and Environmental Engineering: Core qualification: Compu	sorv		
	General Engineering Science (English program): Specialisation Bio	•		
			nnuleor,	
	General Engineering Science (English program): Specialisation En		iipuisory	
	General Engineering Science (English program): Specialisation Pro			
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	Process Engineering: Core qualification: Compulsory			



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



Course L0119: Thermal Separation	Processes		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	f. 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  The students work on tasks in small groups and present their results in front of all students.		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie</li> </ul>		



Course L0141: Thermal Separation	Processes
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	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	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>



Course L1159: Separation Processe	es <u> </u>
Тур	Laboratory Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Compulsory attendence of the colloquia of all experiments and compulsory report.
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	SoSe
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which th
	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 i 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:
	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopi Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann' Enzyklopädie der Technischen Chemie</li> </ul>



Module M0639: Gas and St	eam Power Plants			
Courses				
Title		Тур	Hrs/wk	CP
Gas and Steam Power Plants (L0206)		Lecture	3	4
Gas and Steam Power Plants (L0210)		Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous				
Knowledge	"Technical Thermodynamics I and II"			
	"Heat Transfer"      "Fluid Mechanics"			
	Find Mechanics			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students can evaluate the development of the electricity dem	nand and the energy conversion routes in	the thermal power pl	ant, describe the vario
	types of power plant and the layout of the steam generator blo			
	Additionally they can describe the exhaust gas cleaning appara solar thermal and geothermal power plants or plants equipped wi		conventional tossil-t	uelled power plants w
	The students have basic knowledge about the principles, operation	on and design of turbomachinery		
Skills	The students will be able, using theories and methods of the ene	ergy technology from fossil fuels and base	ed on well-founded kr	nowledge on the functi
	and construction of gas and steam power plants, to identify bas	sic associations in the production of hea	t and electricity, so a	s to develop concept
	solutions. Through analysis of the problem and exposure to the		-	
	the capability and methodology to develop realistic optimal conce			
	the students become the ability to follow better the deliberations	on the electricity mix composition within	the energy-political tr	iangle (economy, sec
	supply and environmental protection).			
	Within the framework of the exercise the students learn the use of	of the specialised software suite EBSILOI	N Professional <sup>TM</sup> . Wit	n this tool small practi
	tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.			
	The students are able to do simplified calculations on turbomachi	nery either as part of a plant, as single co	mponent or at stage le	evel.
Personal Competence				
	An excursion within the framework of the lecture is planned for st	udents that are interested. The students	get in this manner dire	ct contact with a mod
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	power plant in this region. The students will obtain first-hand ex			
	technical and political issues.			
Autonomy	The students assisted by the tutors will be able to develop alon	e simple simulation models and run with	n these scenario ana	yses. In this manner
	theoretical and practical knowledge from the lecture is conso	lidated and the potential effects from c	lifferent process com	binations and bound
	conditions highlighted. The students are able independently to	analyse the operational performance of	of steam power plants	and calculate selec
	quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	<u> </u>		
Credit points	6			
Examination	Written exam			
Examination duration and scale	Written examination of 120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	**		
Curricula	General Engineering Science (German program): Specialisation			.,
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp	**		-
	Energy and Environmental Engineering: Core qualification: Comp	0 0,	us Ellelgy Systems: E	lective Compulsory
	General Engineering Science (English program): Specialisation E		ompulsory	
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program, 7 semester): Spe			/
	General Engineering Science (English program, 7 semester): Spe			
	Mechanical Engineering: Specialisation Energy Systems: Compu	Isory		



Hrswit 3  OP 4  Workload in Hours Independent Study Time 78, Study Time in Lecture 42  Lecture Pot Allone Kather  Language DE  Oycle Wise  Content In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting  Thermodynamic fundamentals  Energy Conversion in thermal power plants  Energy Conversion in thermal power plants  I type of power plant 1  Layout of the power plant 10ck  Individual elements of the power plant 1  Cooling systems  Piue gas cleaning  Operation characteristics of the power plant  Construction materials for power plants  Location of power plants  Location of power plants  Energy balance of a furbomachine  These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues:  Energy balance of a furbomachine  Theory of turbine and compressor stage  Equal and positive pressure blading  Filow losses  Characteristic numbers  Purp and water furbine designs  Design examples of reciprocating engines and furbomachinery  Steam power plants  Gas turbine systems.	Course L0206: Gas and Steam Pow	er Plants
CP Workload in Hours Independent Study Time 78, Study Time in Lecture 42  Lecture Language DE Cycle Wiss Content In the 1st part of the fecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting Thermodynamic fundamentals Energy Conversion in thermal power plants Layout of the power plant Layout of the power plant block Individual elements of the power plant Construction materials for power plant Construction materials for power plant Location of power plants Solar thermal plants/Garbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> 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 burbomachines Pump and water turbine designs Design reautine State power plants Cas turbine systems.	Тур	Lecture
Lecturer   Prof. Altons Kather	Hrs/wk	3
Lecturer Language  Cycle  Wise  Content  In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting  Thermodynamic fundamentals  Energy Conversion in thermal power plants  Propse of power plant  Layout of the power plant bock Individual elements of the power plant  Cooling systems  Flue gas cleaning  Operation characteristics of the power plant  Coorsurucion materials for power plant  Location of power plants  Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>rd</sup> 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 redaures  Hydraulic turbomachines  Pump and water turbine designs  Design examples of reciprocating engines and turbomachinery  Steam power plants  Gas turbine systems.	СР	4
Cycle  Content  In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting  Thermodynamic fundamentals  Energy Conversion in thermal power plants  Types of power plant  Layout of the power plant block  Individual elements of the power plant to Cooling systems  Flue gas cleaning  Operation characteristics of the power plant  Construction materials for power plants  Construction materials for power plants  Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> 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  Pump and water turbine designs  Design examples of reciprocating engines and turbomachinery  Steam power plants  Gas turbine systems.	Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Content  In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:  Electricity demand and Forecasting  Thermodynamic fundamentals  Energy Conversion in thermal power plants  Types of power plant  Layout of the power plant block  Individual elements of the power plant  Cooling systems  Flue gas cleaning  Operation characteristics of the power plant  Construction materials for power plants  Location of power plants  Location of power plants  Energy balance of a turbornachine  These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues:  Energy balance of a turbornachine  Theory of turbine and compressor stage  Equal and positive pressure blading  Flow losses  Characteristic numbers  Axial and radial design  Design features  Hydraulic turbornachines  Pump and water turbine designs  Design examples of reciprocating engines and turbornachinery  Steam power plants  Gas turbine systems.	Lecturer	Prof. Alfons Kather
Content  In the 1st 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 Control of power plants Control of power plants Control of power plants Control of power plants Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2nd part of the module by the more specialised issues:  Energy balance of a turbomachine Theory of turbine and compressor stage Count and positive pressure blading Flow losses Characteristic numbers Avial and radial design Design features Hydraulic turbomachines Pump and water turbine designs Design features Hydraulic turbomachines Pump and water turbine designs Design power plants Gas turbine systems.	Language	DE
Electricity demand and Forecasting Themodynamic fundamentals Energy Conversion in thermal power plants Types of power plant Layout of the power plant lock 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 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water furbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.	Cycle	WiSe
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 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 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.	Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
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 <sup>nd</sup> 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.		Electricity demand and Forecasting
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 plant Location of power plants Location of power plants Location of power plants Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Sieam power plants Gas turbine systems.		Thermodynamic fundamentals
Literature  Literature  Literature  Flue gas cleaming  Loayout of the power plant  Cooling systems  Flue gas cleaming  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 <sup>nd</sup> 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.		Energy Conversion in thermal power plants
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 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.		Types of 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 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.		Layout of the power plant block
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 <sup>nd</sup> 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 Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.		Individual elements of the power plant
Operation characteristics of the power plants 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 <sup>nd</sup> 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 Hydraulic turbomachines Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.		Cooling systems
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 <sup>nd</sup> 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.		Flue gas cleaning
Location of power plants     Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> 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.		
Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.  These are complemented in the 2 <sup>nd</sup> 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.		
These are complemented in the 2 <sup>nd</sup> 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.		
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.		Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.
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		These are complemented in the 2 <sup>nd</sup> part of the module by the more specialised issues:
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		Energy balance of a turbomachine
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		Theory of turbine and compressor stage
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		Equal and positive pressure blading
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		Flow losses
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		Characteristic numbers
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		Axial and radial design
Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems.  Literature  Kalide: Kraft- und Arbeitsmaschinen		Design features
Design examples of reciprocating engines and turbomachinery     Steam power plants     Gas turbine systems.  Literature  Kalide: Kraft- und Arbeitsmaschinen		
Steam power plants Gas turbine systems.  Literature  Kalide: Kraft- und Arbeitsmaschinen		
Gas turbine systems.  Literature      Kalide: Kraft- und Arbeitsmaschinen		
Literature  • Kalide: Kraft- und Arbeitsmaschinen		
Kalide: Kraft- und Arbeitsmaschinen		Gas turbine systems.
Kalide: Kraft- und Arbeitsmaschinen		
Kalide: Kraft- und Arbeitsmaschinen	Literature	
Thomas H. L. Thormische Kroffenlagen, Chringer Verlag, 1005		
		Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006		
Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990		
<ul> <li>Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Tech Verlag Resch / Verlag TÜV Rheinland</li> </ul>		



L0210: Gas and Steam Pow	GI F1811.5
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	
	In the 1 <sup>st</sup> 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 <sub>2</sub> emissions and the resulting climatic effects are a special focus of the lecture and
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discussional power plants and renewable energy sources are discussional power plants.
	and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In
	critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness fo
	responsibility of an engineer's own 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 this tool small tasks
	solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterw
	ask questions and get feedback. The course work has a positive effect on the students final grade.
	active decisions and get received. The course from that a positive circuit of the datacent that grade.
Literature	
	Skripte  Califold Kurft and Arbeits resorbings
	Kalide: Kraft- und Arbeitsmaschinen     Theorea III II: Theorianh Kraftarlesse Carianas Varlag 1995
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985     Strauß K. Kraftanlagen Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990  T. D. H. (Han) Model and D. Francis Double. For the description of the descripti
	T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis
	Verlag Resch / Verlag TÜV Rheinland



Module M0933: Fundamen	als of Materials Science			
Courses				
itle		Тур	Hrs/wk	CP
undamentals of Materials Science I (L10	•	Lecture	2	2
	ranced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2
nysical and Chemical Basics of Materials	Prof. Jörg Weißmüller	Lecture	2	2
	*			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ig learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on a	metals, ceramics and polymers a	and can describe this know	rledge comprehensiv
	Fundamental knowledge here means specifically the issues of	atomic structure, microstructure, ph	ase diagrams, phase transf	ormations, corrosion a
	mechanical properties. The students know about the key aspe	cts of characterization methods for	r materials and can identify	relevant approaches
	characterizing specific properties. They are able to trace materia	Is phenomena back to the underlying	ng physical and chemical lav	vs of nature.
OL III.	The state of the s	and the second s	Harris of making Makedalan	h
Skills	The students are able to trace materials phenomena back to the			
	mechanical properties such as strength, ductility, and stiffness,			
	solidification, precipitation, or melting. The students can explain		conditions and the materials	microstructure, and t
	can account for the impact of microstructure on the material's bel	navior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Environmental Enginee	ring: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compuls	sory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Biomedical Engineerin	ng: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architecture: Co	ompulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Energy and Enviromer	ntal Engineering: Compulso	ry
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Specialisation	Energy and Environmental Engineer	ring: Compulsory	
	General Engineering Science (English program): Specialisation	Mechanical Engineering: Compulse	ory	
	General Engineering Science (English program): Specialisation	Biomedical Engineering: Compulso	ory	
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineerin	ng: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedical Engineerin	g: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Co	mpulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Energy and Enviromen	ntal Engineering: Compulsor	у
	Logistics and Mobility: Specialisation Engineering Science: Elec	tive Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			

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



Course L0506: Fundamentals 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 Chemic	cal Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	Für den Elektromagnetismus:  Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter  Für die Atomphysik:  Haken, Wolf: "Atom- und Quantenphysik", Springer  Für die Materialphysik und Elastizität:  Hornbogen, Warlimont: "Metallkunde", Springer



Module M0670: Particle Ted	chnology and Solids Process Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Particle Technology I (L0434)		Lecture	2	3
Particle Technology I (L0435)		Recitation Section (small)	1	1
Particle Technology I (L0440)		Laboratory Course	2	2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
		lide average and a		
	name and explain processes and unit-operations of so     characterize particles, particle distributions and to discu			
	Characterize particles, particle distributions and to discu	iss their bulk properties		
Skills	Students are able to			
SKIIIS	Students are able to			
	<ul> <li>choose and design apparatuses and processes for soli</li> </ul>	ds processing according to the desired solids	s properties of the pro	oduct
	asses solids with respect to their behavior in solids proceed.	cessing steps		
	<ul> <li>document their work scientifically.</li> </ul>			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with of	per students or scientific personal and to devi	alon colutions for too	hnical-ecientific issues
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 a group.			
Autonomy	Students are able to analyze and solve questions regarding so	lid particles independently		
rationomy	oldadina are able to analyze and solve questions regarding se	na paraoles macponachay.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	on Energy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Energy and Enviromental Eng	ineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	mpulsory		
	General Engineering Science (English program): Specialisation	n Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	n Energy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (English program): Specialisation	n Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): \$	Specialisation Process Engineering: Compul	sory	
	General Engineering Science (English program, 7 semester): \$	Specialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): \$	Specialisation Energy and Enviromental Eng	ineering: Compulsor	/
	Process Engineering: Core qualification: Compulsory			



Course L0434: Particle Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology	
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 Technology	
Тур	Laboratory Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Module M1274: Environme	ntal Technology			
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	The state of the s			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence	The aliming part decesses any, eladerne nave reaction and to	5.10 m.ng .00 m.ng .00 m.ng		
Knowledge	With the completion of this module the students acquire in	a-denth knowledge of important cause-effect ch	ains of notential enviro	nmental problems whi
Knowledge	might occur from production processes, projects or constru			
	in dealing with different methods and instruments to asset environmental processes as well as uncertainties and diffi		its are able to estimate	the complexity of the
Chille	·		-4	
Skills				
	solutions for managing and mitigating environmental pr			
	independently and can apply the software programs Open to critically judge research results or other publications on		g the course the stude	nts have the competen
	to critically judge research results of other publications of	environmental impacis.		
Personal Competence				
Social Competence	The students are able to discuss the various technical ar	nd scientific tasks, both subject-specific and mu	ultidisciplinary. They ar	re able to develop join
	different solutions and to discuss their theoretical or prac-	tical implementation. Due to the selected lectu	re topics, the students	receive insights into
	multi-layered issues of the environment protection and the	he concept of sustainability. Their sensitivity a	and consciousness tow	vards these subjects a
	raised and which helps to raise their awareness of their fut	ture social responsibilities in their role as engin	eers.	
Autonomy	The students learn to research, process and present a so	cientific topic independently. They are able to	carry out independent	scientific work. They ca
	solve an environmental problem in a business context and	d are able to judge results of other publications.		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Speciali	isation Energy and Environmental Engineering: (	Compulsory	
Curricula	General Engineering Science (German program): Speciali			
241104114	General Engineering Science (German program, 7 semes			v
	General Engineering Science (German program, 7 semes			,
	General Engineering Science (German program, 7 semes			
	Bioprocess Engineering: Core qualification: Elective Comp			
1	Energy and Environmental Engineering: Core qualification	•		
	General Engineering Science (English program): Specialis		Compulsory	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semest		•	/
li di		,oatong, andtomonial	.gpaidoi	
	General Engineering Science (English program 7 semest	er): Specialisation Process Engineering: Flective	e Compulsory	
	General Engineering Science (English program, 7 semesti General Engineering Science (English program, 7 semesti			
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest Process Engineering: Core qualification: Elective Compuls	er): Specialisation Bioprocess Engineering: Ele		



Course L0860: Environmental 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	SoSe	
Content	Contaminants: Impact- and Risk Assessment	
	Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)	
	Resource and water consumption: Material flow analysis	
	Energy consumption: Cumulated energy demand (CED), cost analysis	
	Life cycle concept: Life cycle assessment (LCA)	
	Sustainability: Comprehensive product system assessment , SEE-Balance	
	Management: Environmental and Sustainability management (EMAS)	
	Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung	
	Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	

Course L1054: Environmental 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
Language	DE
Cycle	SoSe
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better.
	Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.
Literature	Power point Präsentationen



## **Specialization Biomedical Engineering**

Module M0933: Fundament	als of Materials Science			
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 Materials	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 following	g learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively.			
	Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion are			rmations, corrosion and
	mechanical properties. The students know about the key aspe			
	characterizing specific properties. They are able to trace materia	Is phenomena back to the underlying	g physical and chemical law	s of nature.
Skills	The students are able to trace materials phenomena back to the	e underlying physical and chemical	laws of nature. Materials ph	enomena here refers to
	mechanical properties such as strength, ductility, and stiffness, of			
	solidification, precipitation, or melting. The students can explain			
	can account for the impact of microstructure on the material's bel	navior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Environmental Engineeri	ng: Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulso	ry	
	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	g: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Biomedical Engineering	g: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architecture: Con	npulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Energy and Enviroment	al Engineering: Compulsory	1
	Energy and Environmental Engineering: Core qualification: Com	' '		
	General Engineering Science (English program): Specialisation	Energy and Environmental Engineering	ng: Compulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		У	
	General Engineering Science (English program): Specialisation		0	
	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		ai Engineering: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elec Mechanical Engineering: Core qualification: Compulsory	uve Compuisory		
	Mechatronics: Core qualification: Compulsory  Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		
	100	Sale Sompaisory		



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

Course L0506: Fundamentals 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 Chemic	ad Daving of Materials Colonse	
•	Lecture	
Hrs/wk		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
	Prof. Stefan Müller	
Language		
Cycle	WiSe	
Content	Motivation: "Atoms in Mechanical Engineering?"	
	Basics: Force and Energy	
	The electromagnetic Interaction	
	"Detour": Mathematics (complex e-funktion etc.)	
	The atom: Bohr's model of the atom	
	Chemical bounds	
	The multi part problem: Solutions and strategies	
	Descriptions of using statistical thermodynamics	
	Elastic theory of atoms	
	Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)	
Literature	Für den Elektromagnetismus:	
	Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter	
	Für die Atomphysik:	
	Haken, Wolf: "Atom- und Quantenphysik", Springer	
	Für die Materialphysik und Elastizität:	
	Hornbogen, Warlimont: "Metallkunde", Springer	
	L	



Module M0634: Introductio	n into Medical Technology and Systems			
Courses				
Title		Тур	Hrs/wk	CP
Introduction into Medical Technology and	Systems (L0342)	Lecture	2	3
Introduction into Medical Technology and	Systems (L0343)	Problem-based Learning	4	3
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	none			
Recommended Previous	principles of math (algebra, analysis/calculus)			
Knowledge	principles of stochastics			
	principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	The students can explain medical technology and its princi	ples, including imaging systems, computer air	ded surgery, medical	sensor systems, medical
	information systems. They are able to give an overview of re	gulatory affairs and standards in medical tech	nology.	
Skilla	The students are able to apply principles of medical technol-	agy to polying potual problems		
Skills	The students are able to apply principles of fledical technol	bgy to solving actual problems.		
Personal Competence				
Social Competence	The students describe a problem in medical technology as a	project and define teaks that are solved in a	aint offart	
Social Competence	The students describe a problem in medical technology as a	project, and define tasks that are solved in a j	onit enort.	
Autonomy	The students can reflect their knowledge and document the	results of their work. They can present the resu	ılts in an appropriate n	nanner.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Biomedical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semeste	r): Specialisation Biomedical Engineering: Co	mpulsory	
	Computer Science: Specialisation Computer and Software E	Engineering: Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Compuls	ory		
	General Engineering Science (English program): Specialisa	tion Biomedical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester		npulsory	
	Computational Science and Engineering: Specialisation En			
	Computational Science and Engineering: Specialisation Co			
	Biomedical Engineering: Specialisation Artificial Organs and		/	
	Biomedical Engineering: Specialisation Implants and Endop	• •		
	Biomedical Engineering: Specialisation Medical Technology			
	Biomedical Engineering: Specialisation Management and B	·		
	Technomathematics: Specialisation III. Engineering Science	: Elective Compulsory		

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



Course L0343: Introduction into Medical Technology and Systems	
Тур	Problem-based Learning
Hrs/wk	4
CP	3
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



ourses				
tle		Time	Unatude	CP
		Typ Lecture	Hrs/wk 3	4 4
gnals and Systems (L0432) gnals and Systems (L0433)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(44.94)	·	
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	Walternation 1 0			
	The modul is an introduction to the theory of signals and systems. Goor Further experience with spectral transformations (Fourier series, Fourier to			nematik 1-3 is expe
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-inv	ariant (LTI) systems using meth-	ods of signal and syste	em theory. They are
	to apply the fundamental transformations of continuous-time and discrete	time signals and systems. They	can describe and analy	yse deterministic sig
	and systems mathematically in both time and image domain. In particu	lar, they understand the effects	in time domain and in	mage domain which
	caused by the transition of a continuous-time signal to a discrete-time sign	ıal.		
Skills	The students are able to describe and analyse deterministic signals and	linear time-invariant systems us	ing methods of signal a	and system theory.
	can analyse and design basic systems regarding important properties su	ich as magnitude and phase res	sponse, stability, lineari	ity etc They can as
	the impact of LTI systems on the signal properties in time and frequency d	omain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from appropriate I	iterature sources. They can con	trol their level of know	ledge during the le
	period by solving tutorial problems, software tools, clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrica	al Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Computing			
Garricula	General Engineering Science (German program): Specialisation Process			
	General Engineering Science (German program): Specialisation Process			
	General Engineering Science (German program): Specialisation Civil- an		omnulsory	
	General Engineering Science (German program): Specialisation Mechan		лпракооту	
	General Engineering Science (German program): Specialisation Biomedi			
	General Engineering Science (German program, 7 semester): Specialisation		nulsory	
	General Engineering Science (German program, 7 semester): Specialisat			
	General Engineering Science (German program, 7 semester): Specialisat			
	General Engineering Science (German program, 7 semester): Specialisal			
	General Engineering Science (German program, 7 semester): Specialisal			
	General Engineering Science (German program, 7 semester): Specialisal			mnulsory
	General Engineering Science (German program, 7 semester): Specialisat			
	General Engineering Science (German program, 7 semester): Specialisat			
	General Engineering Science (German program, 7 semester): Specialisal			
	Compulsory	iisation wechanical Engineenii	g, rocus materiais iri	Linginieering Scien
	General Engineering Science (German program, 7 semester): Specialisat	tion Mechanical Engineering, Fo	cus Mechatronics: Com	npulsorv
	General Engineering Science (German program, 7 semester): Special			
	Compulsory		,,	
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	d Enviromental Engeneering: Cc	mpulsory	
	General Engineering Science (English program): Specialisation Bioproce			
	General Engineering Science (English program): Specialisation Electrica			
	General Engineering Science (English program): Specialisation Compute	0 0 1 7		
	General Engineering Science (English program): Specialisation Mechani			
	General Engineering Science (English program): Specialisation Biomedia			
	General Engineering Science (English program): Specialisation Process	Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisati		oulsory	
	General Engineering Science (English program, 7 semester): Specialisati		•	
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Specialisati			npulsory
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Specialisati	-	• •	
	General Engineering Science (English program, 7 semester): Special			
	Compulsory			5 - 5 - 5 - 5 - 5 - 5 - 5
	General Engineering Science (English program, 7 semester): Specialisati	ion Mechanical Engineering, For	cus Mechatronics: Com	pulsory
	General Engineering Science (English program, 7 semester): Specialisation			
	Compulsory		,	
l l				
	Computational Science and Engineering: Core qualification: Compulsory			



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



Module M0680: Fluid Dynar	mics			
Courses				
Title		Тур	Hrs/wk	CP
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Lecture	3 2	4
	Durf Thomas Durin	Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	none			
Recommended Previous	Sound knowledge of engineering mathematics, engineering mech	nanics and thermodynamics.		
Knowledge	After the Property of the state	Lancette and the		
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the			
	outline the rationale of flow physics using mathematical models	and are familiar with methods for the per	formance analysis a	and the prediciton of fluid
	engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-p	hysics models for the analysis of technical	al systems. The lectu	re enables the student to
	carry out all necessary theoretical calculations for the fluid dynamic	c design of engineering devices on a scie	entific level.	
B				
Personal Competence	The objects on objects the discount of the second School of the second school of	office and and a site of		
Social Competence	The students are able to discuss problems and jointly develop sol	ution strategies.		
4.4	The state of the s	and the second for a second second section of the second		
Autonomy	The students are able to develop solution strategies for complex p	roblems self-consistent and crtically analy	/se results.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation I	Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation I			
Jarrioula	General Engineering Science (German program): Specialisation I			
	General Engineering Science (German program, 7 semester): Spo		npulsorv	
	General Engineering Science (German program, 7 semester): Spe	• •		
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (English program): Specialisation N	lechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation E	iomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation N	laval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Biomedical Engineering: Com	oulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Naval Architecture: Compulsor	у	
	Computational Science and Engineering: Specialisation Engineer	ring Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elec	tive Compulsory		

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



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



Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1138)  Recitation Section (small) 2				2
	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	wing learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic precedure used in mechanics	contexts:		
	<ul> <li>describe the axiomatic procedure used in mechanica</li> <li>explain important steps in model design;</li> </ul>	oonoxo,		
	<ul> <li>present technical knowledge.</li> </ul>			
	procent tooming a thrown edge.			
Skills	The students can			
	explain the important elements of mathematical / med	nanical analysis and model formation, and an	nly it to the context of	their own problems:
	<ul> <li>apply basic methods to engineering problems;</li> </ul>	namear analysis and moder formation, and ap	pry it to the context of	their own problems,
	<ul> <li>estimate the reach and boundaries of the methods an</li> </ul>	d extend them to be applicable to wider proble	em sets	
	estimate the reach and boundaries of the methods an	d extend them to be applicable to wider proble	3111 3013.	
Personal Competence				
Social Competence	The students can work in groups and support each other to a	vorceme difficulties		
Social Competence	The students can work in groups and support each other to o	vercome difficulties.		
Autonomy	Students are capable of determining their own strengths and	weaknesses and to organize their time and le	arning based on thos	se.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
	6			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisa			
Curricula	General Engineering Science (German program): Specialisa			
	General Engineering Science (German program): Specialisa			
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 semester	·	ory	
	General Engineering Science (English program): Specialisat General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program, 7 semester)	, ,	nulsory	
	General Engineering Science (English program, 7 semester)			
	General Engineering Science (English program, 7 semester)	,		
	Mechanical Engineering: Core qualification: Compulsory	. oposansanom maran montrolaro. Odmpulso	• ,	
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Complement			

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	- Simple impact problems
	- Principles of analytical mechanics
	- Elements of vibration theory
	- Basics of continuum vibrations
	- Introduction into Modeling of Multibody Systems
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).



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

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



Module M1277: MED I: Intro	oduction to Anatomy
0	
Courses	To Hand OR
Title Introduction to Anatomy (L0384)	Typ Hrs/wk CP  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 common diseases; they can explain the relevanc 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 competently in conversations on the topic and acquire the
,	relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0384: Introduction to Anato	оту
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange
Language	
Cycle	
Content	General Anatomy
	1 <sup>st</sup> week: The Eucaryote Cell
	2 <sup>nd</sup> week: The Tissues
	3 <sup>rd</sup> week: Cell Cycle, Basics in Development
	4 <sup>th</sup> week: Musculoskeletal System
	5 <sup>th</sup> week: Cardiovascular System
	6 <sup>th</sup> week: Respiratory System
	7 <sup>th</sup> week: Genito-urinary System
	8 <sup>th</sup> week: Immune system
	9 <sup>th</sup> week: Digestive System I
	10 <sup>th</sup> week: Digestive System II
	11 <sup>th</sup> week: Endocrine System
	12 <sup>th</sup> week: Nervous System
	13 <sup>th</sup> week: Exam
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012



irses			Here finds	0.0
duction to Radiology and Radiation Th	nerany (1 0383)	Typ Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Prof. Ulrich Carl	Leotare		-
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Therapy			
	The students can distinguish different types of curre	antly used equipment with respect to its use in radia	ation therapy.	
	The students can explain complex treatment plans	used in radiation therapy in interdisciplinary conte	xts (e.g. surgery, internal me	edicine).
	The students can describe the patients' passage fro	om their initial admittance through to follow-up care	<b>.</b>	
	Diagnostics			
	The students can illustrate the technical base co imaging techniques (CT, MRT, US).	ncepts of projection radiography, including angion	ography and mammograph	ny, as well as sectio
	The students can explain the diagnostic as well as	therapeutic use of imaging techniques, as well as t	the technical basis for those	techniques.
	The students can choose the right treatment methor	d depending on the patient's clinical history and ne	eds.	
	The student can explain the influence of technical e	errors on the imaging techniques.		
	The student can draw the right conclusions based of	on the images' diagnostic findings or the error proto	ocol.	
Skills				
Skills	Therapy			
		a cituations and motivate why they come to that con-	aduaian	
	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 rac energy needed in that situation (irradiation planning		ne situation (location of the	tumor) and choose
	The student can assess what an individual psychosocial services, psycho-oncology).	atment, sports, social help g	roups, self-help grou	
	Diagnostics			
	The students can suggest solutions for repairs of im	naging instrumentation after having done error ana	alvses	
	The students can classify results of imaging techni pathophysiology.	ques according to different groups of diseases ba	sed on their knowledge of a	anatomy, pathology a
Personal Competence				
Social Competence				
	The students can assess the special social situation	n of tumor patients and interact with them in a profe	essional way.	
	The students are aware of the special, often fear-do	ominated behavior of sick people caused by diagn	nostic and therapeutic measi	ures and can meet th
	appropriately.			
Autonomy				
	The students can apply their new knowledge and s	kills to a concrete therapy case.		
	The students can introduce younger students to the	clinical daily routine.		
	The students are able to access anatomical known relevant knowledge themselves.	wledge by themselves, can participate competer	ntly in conversations on the	e topic and acquire
Workload in Hours	Independent Study Time 62, Study Time in Lecture	28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): S			
O. mula - 1-	General Engineering Science (German program): S General Engineering Science (German program, 7			
Curricula	Jg ( Soman program, 7			maulaan
Curricula	General Engineering Science (German program, 7	semester). Opecialisation wechanical Engineering		ripuisory
Curricula	General Engineering Science (German program, 7 Electrical Engineering: Specialisation Medical Tech		9,	ripulsory
Curricula	Electrical Engineering: Specialisation Medical Tech General Engineering Science (English program): S	hnology: Elective Compulsory Specialisation Mechanical Engineering, Focus Bion	mechanics: Compulsory	npulsory
Curricula	Electrical Engineering: Specialisation Medical Tech	hnology: Elective Compulsory Specialisation Mechanical Engineering, Focus Bion Specialisation Biomedical Engineering: Compulsor	mechanics: Compulsory	



Mechanical Engineering: Specialisation Biomechanics: Compulsory
Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0383: Introduction to Radio	ology and Radiation Therapy
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer Language	Prof. Ulrich Carl, Prof. Thomas Vestring  DE
Cycle	SoSe
Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments
Literature	"Technik der medizinischen Radiologie" von T. + J. Laubenberg –
	7. Auflage – Deutscher Ärzteverlag – erschienen 1999
	"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
	4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
	ISBN: 978-3-437-23960-1
	"Strahlentherapie und Onkologie für MTA-R" von R. Sauer –
	5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschienen 08.12.2009
	ISBN: 978-3-437-47501-6
	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	"Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000



Module M0684: Heat Trans	ier			
module mood. Heat Halls	loi			
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an approach	ch.		
Autonomy	The students are able to develop a complex problem self-consistent and	analyse the results in a critical w	ay. A qualified exchan	ge with other students is
	given.			
Wantsland in Harris	Indiana adout Chidu Timo 110 Chidu Timo in Lochius 70			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min	ded Early Street		
Assignment for the Following	General Engineering Science (German program): Specialisation Mechan			
Curricula	General Engineering Science (German program): Specialisation Mechan		Systems: Compulsory	
	General Engineering Science (German program): Specialisation Biomed		aal Maahaniaal Engina	oring: Compulacry
	General Engineering Science (German program): Specialisation Mechan			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specia	iisalion wechanical Engineening	i, rocus ineoretical iv	lechanical Engineening.
	Compulsory	tion Diamodical Engineering: Co.	maulaani	
	General Engineering Science (German program, 7 semester): Specialisa General Engineering Science (English program): Specialisation Biomedi		привогу	
	General Engineering Science (English program): Specialisation Biomedi General Engineering Science (English program): Specialisation Mechan		anice: Compulsory	
	General Engineering Science (English program): Specialisation Mechan			
	General Engineering Science (English program): Specialisation Mechan General Engineering Science (English program): Specialisation Mechan	0 0,	, , ,	ering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Median			
	General Engineering Science (English program, 7 semester): Specialisal			
	Compulsory		, . ccas moorewall	
	General Engineering Science (English program, 7 semester): Specialisat	tion Biomedical Engineering: Cor	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulsory	3 3. 40.		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineer	ering: Compulsory		
	<u> </u>	· · · · · · · · · · · · · · · · · · ·		

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, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z. Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



Courses				
Γitle		Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD (L0268)		Lecture	2	1
Mechanical Design Project I (L0695)		Practical Course	3	2
Mechanical Design Project II (L0592)		Practical Course	3	2
eam Project Design Methodology (L0267		Problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering Design	1		
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	The many particulations, statement are reached and	iono ming roaming rootate		
Knowledge	After passing the module, students are able to:			
· ·				
	explain design guidelines for machinery parts e.g	i. considering load situation, materials and mani	utacturing requirements	5,
	describe basics of 3D CAD,			
	<ul> <li>explain basics methods of engineering designing</li> </ul>			
Skills	After passing the module, students are able to:			
	<ul> <li>independently create sketches, technical drawing</li> </ul>	gs and documentations e.g. using 3D CAD,		
	design components based on design guidelines autonomously,			
	dimension (calculate) used components,			
	use methods to design and solve engineering design tasks systamtically and solution-oriented,			
	<ul> <li>apply creativity techniques in teams.</li> </ul>			
Personal Competence				
Social Competence	After passing the module, students are able to:			
oodal oompelence	Alter passing the module, students are able to:			
	<ul> <li>develop and evaluate solutions in groups includir</li> </ul>	ng making and documenting decisions,		
	moderate the use of scientific methods,			
	present and discuss solutions and technical draw			
	reflect the own results in the work groups of the co	ourse.		
Autonomy	Students are able			
		the constitution of the facilities for the constitution of the con		
	to estimate their level of knowledge using activa     To solve engineering design tasks systematically		rs),	
	<ul> <li>To solve engineering design tasks systematically</li> </ul>			
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specia	alisation Energy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specia	alisation Mechanical Engineering: Compulsory		
	General Engineering Science (German program): Specia			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory  General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Special General Engineering Science (English program): Special		Compulsory	
	General Engineering Science (English program): Special General Engineering Science (English program): Special			
	General Engineering Science (English program, 7 seme		ompulsorv	
	General Engineering Science (English program, 7 semes	, ,		
	General Engineering Science (English program, 7 semes			v
	Mechanical Engineering: Core qualification: Compulsory		goomig. Oompuisoi	,
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



Course L0268: Embodiment 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	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>

Course L0695: Mechanical Design F	Project I
Тур	Practical Course
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	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	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>



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

Course L0267: Team Project Design	n Methodology
Тур	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	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Module M0956: Measureme	ent Technology for Mechanical and Process E	Engineers			
Courses					
Title		Тур	Hrs/wk	СР	
Practical Course: Measurement and Conti	rol Systems (L1119)	Laboratory Course	2	2	
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3	
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1	
Module Responsible	Dr. Sven Krause				
Admission Requirements	none				
Recommended Previous	Basic knowledge of physics, chemistry and electrical enginee	ring			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results			
Professional Competence					
Knowledge	Students are able to name the most important fundmentals of	of the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static ar	
	Dynamic Properties of Sensors and Systems).				
	They can outline the most important measuring methods for o	different kinds of quantities to be maesured (	Electrical Quantities.	Temperature, mechanic	
	quantities, Flow, Time, Frequency).				
	They can describe important methods of chemical Analysis (G	Gas Sensors, Spectroscopy, Gas Chromatogr	aphy)		
Skills	Students can select suitable measuring methods to given pro-	blems and can use refering measurement de	vices in practice.		
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues in				
	the right context and application area.	area of measurement technology and solution	лі арріоаспез аз жеі	i as piace the issues in	
	are ngm comon and approximation area.				
Personal Competence					
Social Competence	Students can arrive at work results in groups and document the	nem in a common report.			
Autonomy	Students are able to familiarize themselves with new measure	ement technologies.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	105 minutes				
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Energy and Environmental Engineering: (	Compulsory		
Curricula	General Engineering Science (German program): Specialisat		ompulsory		
Garriodia					
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Process Engineering: Compulsory				
	General Engineering Science (German program). Specialisation Process Engineering. Compulsory  General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering. Compulsory				
	General Engineering Science (German program, 7 semester)				
	General Engineering Science (German program, 7 semester): Specialisation Bromedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory				
	Energy and Environmental Engineering: Core qualification: C		-		
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program): Specialisati	on Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering: Co	mpulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engineering: Cor	npulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Compu	ilsory		
	Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Process Engineering: Core qualification: Compulsory				



,,	Laboratory Course
Hrs/wk	
	2
	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Wolfgang Schröder
. 33.	DE
Cycle	WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants 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	Versuch 1:
	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftlich Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münche Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul> Versuch 2:
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze
	Versuch 3:
	<ul> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	Versuch 4:
	<ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



Course L1116: Measurement Techn	nology for Mechanical and Process Engineers
Тур	
Hrs/wk	
CP Workload in Hours	3 Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Language	DE
Cycle	WiSe
Content	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front of the class.
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 Techn	course L1118: Measurement Technology for Mechanical and Process Engineers	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses itle tumerical Mathematics I (L0417) tumerical Mathematics I (L0418)				
itle umerical Mathematics I (L0417)				
lumerical Mathematics I (L0417)		Typ	Hrs/wk	CP
		Typ Lecture	nrs/wk 2	3
		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
-	None			
	Notice			
Recommended Previous  Knowledge	Mathematik I + II for Engineering Students (german or	english) <b>or</b> Analysis & Linear Algebra I + II for	Technomathematici	ans
Kilowieuge	<ul> <li>basic MATLAB knowledge</li> </ul>			
Educational Objections	Afficial Comment of the state of the City	at a site a section of a section		
	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration	n, least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and to
	explain their core ideas,			
	repeat convergence statements for the numerical met	nods,		
	explain aspects for the practical execution of numerical	al methods with respect to computational and	storage complexitx.	
Skills	Students are able to			
	<ul> <li>implement, apply and compare numerical methods us</li> </ul>			
	justify the convergence behaviour of numerical metho		gorithm,	
	select and execute a suitable solution approach for a	given problem.		
Personal Competence				
-	Students are able to			
,				
	<ul> <li>work together in heterogeneously composed teams</li> </ul>			edge), explain theoretica
	foundations and support each other with practical asp	ects regarding the implementation of algorithr	ns.	
Autonomy	Students are capable			
,				
	<ul> <li>to assess whether the supporting theoretical and prac</li> </ul>		or in a team,	
	<ul> <li>to assess their individual progess and, if necessary, to</li> </ul>	ask questions and seek help.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
	6			
	Written exam			
	90 minutes			
		in Committee Calaman Committee		
	General Engineering Science (German program): Specialisat		aniaa: Campulaani	
	General Engineering Science (German program): Specialisat			anna Campulaan
	General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat		in Engineering Scien	ices. Compulsory
	General Engineering Science (German program, 7 semester)		an.	
	General Engineering Science (German program, 7 semester)	·	-	Engineering Sciences
	Compulsory	ter). Specialisation Mechanical Engineering	, rocus Materiais II	T Linginieering Sciences
	General Engineering Science (German program, 7 semester)	: Specialisation Biomedical Engineering: Con	nulsory	
	General Engineering Science (German program, 7 semester)			mnulson/
		, , , , , , , , , , , , , , , , , , , ,	do Biomeonames. Oc	mpaloory
			inics: Compulsorv	
				ices: Compulsorv
		* *		
	General Engineering Science (English program, 7 semester).			Engineering Sciences
	Compulsory	, -,	,	.gg 20.0/1000
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engineering: Com	pulsory	
			i	
		Specialisation Mechanical Engineering, Foci	us Biomechanics: Co	mpulsory
	General Engineering Science (English program, 7 semester): Computational Science and Engineering: Core qualification:		us Biomechanics: Co	mpulsory
	Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathematic Electrical Engineering: Core qualification: Elective Compulso General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):	ss: Elective Compulsory  ry  on Computer Science: Compulsory  on Biomedical Engineering: Compulsory  on Mechanical Engineering, Focus Biomecha  on Mechanical Engineering, Focus Materials	in Engineering Scien	ices: Compulsor,



Course L0417: Numerical Mathema	tics 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, Dr. Patricio Farrell
Language	DE/EN
Cycle	WiSe
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>
Literature	Stoer/Bulirsch: Numerische Mathematik 1, Springer     Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer

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



Module M1279: MED II: Intro	oduction to Biochemistry and Molec	ular Biology		
Courses				
Title		Тур	Hrs/wk	CP
ntroduction to Biochemistry and Molecula	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	The students can			
· ·				
	describe basic biomolecules;			
	explain how genetic information is coded			
	explain the connection between DNA and	proteins;		
Skills	The students can			
	recognize the importance of molecular pa			
	describe selected molecular-diagnostic pr			
	explain the relevance of these procedures	s for some diseases		
Personal Competence				
Social Competence	The students can participate in discussions in res	earch and medicine on a technical level.		
Autonomy	The students can develop understanding of topic	s from the course, using technical literature, by themsel	lves.	
Workload in Hours	Independent Study Time 62, Study Time in Lectur	re 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following		: Specialisation Mechanical Engineering, Focus Biome	echanics: Compulsory	
Curricula		: Specialisation Biomedical Engineering: Compulsory	chanics. Compulsory	
Odificula		7 semester): Specialisation Biomedical Engineering: Computation	Compulsory	
		7 semester): Specialisation Mechanical Engineering, F		mnulsony
	Electrical Engineering: Specialisation Medical Te	, ,	occo Diomocriamos. Ooi	
		Specialisation Mechanical Engineering, Focus Biomed	chanics: Compulsory	
		Specialisation Biomedical Engineering: Compulsory	onamos. Compaisory	
		7 semester): Specialisation Mechanical Engineering, F	ocus Biomechanics: Con	nulsory
		7 semester): Specialisation Biomedical Engineering: C		ipuisory
	Mechanical Engineering: Specialisation Biomech	, ,	ompulsory	
		nanics. Compuisory nent and Business Administration: Elective Compulsor	v	
		organs and Regenerative Medicine: Elective Compulsor Organs and Regenerative Medicine: Elective Compulsor	•	
			OI y	
		Technology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants Technomathematics: Core qualification: Elective	' ' '		
	· ·			
	Technomathematics: Specialisation III. Engineeri	ng science. Liective Compulsory		

cture
dependent Study Time 62, Study Time in Lecture 28
of. Hans-Jürgen Kreienkamp
Se
iller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage
ffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008
Se



Module M1333: BIO I: Impla	nts and Fracture Healing			
Courses				
Title		Тур	Hrs/wk	CP
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	ore attending "Implants and Fracture	e Healing".	
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	The students can describe the different ways how bones heal, and	the requirements for their existence	).	
	The students can name different treatments for the spine and hollow	w bones under given fracture morph	nologies.	
Skills	The students can determine the forces acting within the human boo	ly under quasi-static situations unde	er specific assumptions.	
Personal Competence				
Social 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			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation M	echanical Engineering, Focus Biom	nechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Bi	omedical Engineering: Compulsory	/	
	General Engineering Science (German program, 7 semester): Spec	cialisation Mechanical Engineering	, Focus Biomechanics: Con	npulsory
	General Engineering Science (German program, 7 semester): Spec	cialisation Biomedical Engineering:	Compulsory	
	General Engineering Science (English program): Specialisation Bio	omedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Me	echanical Engineering, Focus Biom	echanics: Compulsory	
	General Engineering Science (English program, 7 semester): Spec	ialisation Mechanical Engineering,	Focus Biomechanics: Com	pulsory
	General Engineering Science (English program, 7 semester): Spec	ialisation Biomedical Engineering:	Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsor	у		
	Biomedical Engineering: Specialisation Artificial Organs and Rege	nerative Medicine: Elective Compul	Isory	
	Biomedical Engineering: Specialisation Implants and Endoprosthe	ses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and C	ontrol Theory: Elective Compulsory	1	
	Biomedical Engineering: Specialisation Management and Busines	s Administration: Elective Compulso	ory	
	Technomathematics: Specialisation III. Engineering Science: Electi	ve Compulsory		



Course L0376: Implants and Fractur	re Healing
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock DE
Language	WiSe WiSe
Content	
	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



	s of Management			
courses				
ïtle		Тур	Hrs/wk	CP
ntroduction to Management (L0880)		Lecture	3	3
roject Entrepreneurship (L0882)		Problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	After taking part auguspafully, at idente have reached the following	looming rocults		
Educational Objectives Professional Competence	After taking part successfully, students have reached the following	learning results		
Knowledge	After taking this module, students know the important basics of m	any different areas in Business and Man	agement from Plant	ning and Organisatio
Miomoage	Marketing and Innovation, and also to Investment and Controlling		lagement, nom i lam	mig and organisatio
	explain the differences between Economics and Managen  California  Califo	nent and the sub-disciplines in Manageme	ent and to name impo	ortant definitions from
	field of Management	amont and name the most important aspec	ote of ontropropurial r	projects
	<ul> <li>explain the most important aspects of and goals in Manage</li> <li>describe and explain basic business functions as produce</li> </ul>			
	ressource management, information management, innova		snam management, c	organization and nui
	explain the relevance of planning and decision making it		tiple objectives and	uncertainty, and exp
	some basic methods from mathematical Finance			,
	state basics from accounting and costing and selected con	trolling methods.		
0	la			
Skills	Students are able to analyse business units with respect to	o different criteria (organization, object	tives, strategies etc.	.) and to carry out
	Entrepreneurship project in a team. In particular, they are able to			
	analyse Management goals and structure them appropriat	ely		
	<ul> <li>analyse organisational and staff structures of companies</li> </ul>			
	<ul> <li>apply methods for decision making under multiple objective</li> </ul>	es, under uncertainty and under risk		
	<ul> <li>analyse production and procurement systems and Busines</li> </ul>	s information systems		
	<ul> <li>analyse and apply basic methods of marketing</li> </ul>			
	<ul> <li>select and apply basic methods from mathematical finance</li> </ul>			
	<ul> <li>apply basic methods from accounting, costing and controll</li> </ul>	ng to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	La constantina de la constantina della constanti			
	work successfully in a team of students      to apply their knowledge from the leature to an entraprene	urabin project and write a caberent report	on the project	
	<ul> <li>to apply their knowledge from the lecture to an entreprene</li> <li>to communicate appropriately and</li> </ul>	ariship project and write a conferent report	on the project	
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	<ul> <li>work in a team and to organize the team themselves</li> </ul>			
	to write a report on their project.			
	<u> </u>			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes	Tartist Facility Committee		
		electrical Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisation I	Computer Colones: Compulsory		
	General Engineering Science (German program): Specialisation (			
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (	Process Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (German program): Specialisation (German program)	Process Engineering: Compulsory Bioprocess Engineering: Compulsory	ompulsorv	
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program))	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co		
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (German program): Specialisation (German program)	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Con		
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program))	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program))	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Environental Engineering: Co Bivil- and Environental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (German program): Specialisation (General Engineering Science (German program): Specialisation (General Engineering Science (German program))	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Blaval Architecture: Compulsory	npulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program): Specialisation (German program): Specialisation (General Engineering Science (German program))	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Environmental Engineering: Co Bivil- and Environmental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Blaval Architecture: Compulsory Biolalisation Electrical Engineering: Compulsory	ulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation (General Engineering Science (German program, 7 semester): Specialisation (General Engineering Science (German program, 7 semester): Specialisation (German program):	Process Engineering: Compulsory Dioprocess Engineering: Compulsory Dioprocess Engineering: Compulsory Dioprocess Engineering: Compulsory Divil- and Enviromental Engeneering: Compulsory Diomedical Engineering: Compulsory Diaval Architecture: Compulsory Dioprocess Engineering: Compulsory Dioproces	ulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program): Specialisation of General Engineering Science (Germa	Process Engineering: Compulsory Dioprocess Engineering: Compulsory Dioprocess Engineering: Compulsory Dioprocess Engineering: Compulsory Dioprocess Engineering: Compulsory Diomedical Engineering: Compulsory Diomedical Engineering: Compulsory Dioprocess Engineer	ulsory sory pulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program)	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Blaval Architecture: Compulsory Biolalisation Electrical Engineering: Compulsory Biotalisation Process Engineering: Compulsory Biotalisation Biomedical Engineering: Compulsory Biotalisation Naval Architecture: Compulsory Biotalisation Naval Architecture: Compulsory Biotalisation Naval Architecture: Compulsory	ulsory sory spulsory ry	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program)	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedic	ulsory lsory pulsory ry pry	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program)	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedic	ulsory lsory lsory ipulsory ry iry ipulsory y	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engine	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedic	ulsory lsory lpulsory ry ingulsory y y jineering: Compulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engine	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Foculty Biomedical Engineering, Fo	ulsory lsory lsory upulsory ry upulsory y jupulsory y jineering: Compulsor	npulsory
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Scienc	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Engineering: Engineering: Engineering, Focus Biomedical Engineering,	ulsory lsory lsory lpulsory ry lpulsory y lpulsory y ineering: Compulsor us Mechatronics: Con us Biomechanics: Coi	npulsory mpulsory
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Scienc	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Confectanical Engineering: Compulsory Biomedical Engineering: Focus Biomedical Engineering, Focus	ulsory lsory lsory lpulsory lpulsory lpulsory lpulsory lpulsory lpulsory lpulsory lsory ls	npulsory mpulsory ngineering: Compuls
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of Generalisation of Generalisation of Generalisation of German program, 7 semester): Specialisation of Generalisation of Generalisation of German program, 7 semester): Specialisati	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Confectanical Engineering: Compulsory Biomedical Engineering: Focus Biomedical Engineering, Focus	ulsory lsory lsory lpulsory lpulsory lpulsory lpulsory lpulsory lpulsory lpulsory lsory ls	npulsory mpulsory ngineering: Compuls
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of Generalisering Science (German program, 7	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Focus Biomedical Engineering, Focu	ulsory disory disory dispulsory d	npulsory mpulsory ngineering: Compuls Engineering Scien
Assignment for the Following	General Engineering Science (German program): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of General Engineering Science (German program, 7 semester): Specialisation of Generalisation of Generalisation of Generalisation of German program, 7 semester): Specialisation of Generalisation of Generalisation of German program, 7 semester): Specialisati	Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Divil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Focus Biomedical Engineering, Focu	ulsory disory disory dispulsory d	npulsory mpulsory ngineering: Compuls Engineering Scien



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

compulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory
Energy and Environmental Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Compulsory\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Mechanical\ Engineering,\ M$ 

General Engineering Science (English program, 7 semester); Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

 $\label{thm:mechanical engineering: Core qualification: Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfga
Lecturer	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales</li> <li>Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	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.

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



Module M1280: MED II: Intr	oduction to Physiology
Courses	
Title	Typ Hrs/wk CP
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;
	describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology.
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and v
Simb	functions) and relate them to similar technical systems.
Personal Competence	,
Social Competence	The students can conduct discussions in research and medicine on a technical level.
	The students can find solutions to problems in the field of physiology, both analytical and metrological.
Autonomy	The students can derive answers to questions arising in the course and other physiological areas, using technical literature, by themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Technomathematics: Core qualification: Elective Compulsory  Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Technomaticinates, operatisation in Engineering Science, Elective Computatory

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. Roger Zimmermann
Language	DE
Cycle	SoSe
Content	
Literature	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme
	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier



Module M1332: BIO I: Expe	rimental Methods in Biomechanics			
Courses				
Title		Тур	Hrs/wk	CP
Experimental Methods in Biomechanics (L	0377)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate und I	Frakturheilung" before attending "Experimentelle	Methoden".	
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	The students can describe the different ways how be	ones heal, and the requirements for their existen	ce.	
	The students can name different treatments for the s	pine and hollow bones under given fracture mor	phologies.	
	The students can describe different measurement to	echniques for forces and movements, and choose	e the adequate technique for	r a given task.
Skills	The students can describe the basic handling of sev	veral experimental techniques used in biomecha	nics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic experiment	tal tasks.		
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -			
Autonomy	The students can, in groups, solve basic experiment	tal tasks.		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 2	28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): S	pecialisation Mechanical Engineering, Focus Bio	omechanics: Compulsory	
Curricula	General Engineering Science (German program): S	pecialisation Biomedical Engineering: Compulso	ory	
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engineering	ng, Focus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 s	semester): Specialisation Biomedical Engineerin	g: Compulsory	
	General Engineering Science (English program): Sp	pecialisation Biomedical Engineering: Compulso	ry	
	General Engineering Science (English program): Sp	pecialisation Mechanical Engineering, Focus Bio	mechanics: Compulsory	
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical Engineerin	g, Focus Biomechanics: Cor	mpulsory
	General Engineering Science (English program, 7 s	emester): Specialisation Biomedical Engineering	g: Compulsory	
	Mechanical Engineering: Specialisation Biomechan	nics: Compulsory		
	Biomedical Engineering: Specialisation Artificial Organical	gans and Regenerative Medicine: Elective Comp	oulsory	
	Biomedical Engineering: Specialisation Implants an	d Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Ted	chnology and Control Theory: Elective Compulso	ory	
	Biomedical Engineering: Specialisation Manageme	nt and Business Administration: Elective Compu	Isory	
	Technomathematics: Specialisation III. Engineering	Science: Flective Compulsory		

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



## **Specialization Naval Architecture**

Module M0933: Fundamen	tals of Materials Science			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L10	85)	Lecture	2	2
Fundamentals of Materials Science II (Adv	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials	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 followir	ng learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on i	metals, ceramics and polymers a	nd can describe this knowle	edge comprehensively
_	Fundamental knowledge here means specifically the issues of			
	mechanical properties. The students know about the key aspe	ects of characterization methods for	materials and can identify r	elevant approaches for
	characterizing specific properties. They are able to trace materia	ls phenomena back to the underlyin	ng physical and chemical law	s of nature.
Skills	The students are able to trace materials phenomena back to the			
	mechanical properties such as strength, ductility, and stiffness,			
	solidification, precipitation, or melting. The students can explain		conditions and the materials i	nicrostructure, and they
	can account for the impact of microstructure on the material's bel	havior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Enviromental Engineer	ring: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulso	ory	
	General Engineering Science (German program): Specialisation			
	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	•	ntal Engineering: Compulsory	
	Energy and Environmental Engineering: Core qualification: Com			
	General Engineering Science (English program): Specialisation	•		
	General Engineering Science (English program): Specialisation		•	
	General Engineering Science (English program): Specialisation		ory	
	General Engineering Science (English program): Specialisation			
	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		tai Engineering: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elec	Tive Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory	antina Camandaan		
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		



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

Course L0506: Fundamentals of Ma	terials 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 Chemic	cal 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



	ons of Management		
urses			
9	Тур	Hrs/wk	СР
oduction to Management (L0880)	Lecture	3	3
ect Entrepreneurship (L0882)	Problem-based Learning	2	3
Module Responsible	le Prof. Christoph Ihl		
Admission Requirements	ks None		
Recommended Previous	Basic Knowledge of Mathematics and Business		
Knowledge	je		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	e		
Knowledge	After taking this module, students know the important basics of many different areas in Business and M Marketing and Innovation, and also to Investment and Controlling. In particular they are able to	lanagement, from Plan	ning and Organisation
	<ul> <li>explain the differences between Economics and Management and the sub-disciplines in Manage field of Management</li> </ul>	ment and to name imp	ortant definitions from
	explain the most important aspects of and goals in Management and name the most important aspects.	pects of entreprneurial	projects
	<ul> <li>describe and explain basic business functions as production, procurement and sourcing, suppl</li> </ul>		
	ressource management, information management, innovation management and marketing		
	• explain the relevance of planning and decision making in Business, esp. in situations under m	nultiple objectives and	uncertainty, and expl
	some basic methods from mathematical Finance		
	<ul> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>		
Skills	Its Students are able to analyse business units with respect to different criteria (organization, object Entrepreneurship project in a team. In particular, they are able to	ectives, strategies etc	c.) and to carry out
	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		
	analyse and apply basic methods of marketing     select and apply basic methods from mathematical finance to predefined problems		
	apply basic methods from accounting, costing and controlling to predefined problems		
	apply basic metrode normal accounting, cooling and confidence of problems		
Personal Competence	e e		
Social Competence	ce 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	ort on the project	
	to communicate appropriately and		
	to cooperate respectfully with their fellow students.		
Autonomy	ny 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	ts 6		
Examination	on Written exam		
Examination duration and scale	le 90 Minuten		
Assignment for the Following			
Curricula			
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering:	Compulsory	
		ompulsory	
	General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: C	· · · · · · · · · · · · · · · · · · ·	
	General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: C General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory	omparco. y	
		opaico.;	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory	opaiso.,	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory	npulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Com	npulsory oulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering Science (German program): Specialisation Process Engineering General	npulsory pulsory pmpulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program) General Engineering Science (German program) General Engineering General	npulsory pulsory pmpulsory sory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program) Specialisation Naval Architecture: Compulsory General Engineering Science (German program) Specialisation Naval Architecture: Compulsory General Engineering Science (German program) Specialisation Naval Architecture: Compulsory General Engineering Science (German program) Specialisation Science (Ger	npulsory pulsory pmpulsory sory lsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Computer Science (German program, 7 semester): Specialisation Computer Science: Computer Science (German program, 7 semester): Specialisation Computer Science: Computer Science (German program, 7 semester): Specialisation Computer Science (German program, 7	npulsory pulsory pompulsory sory lsory pompulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering: Computer Science (German program, 7 semester): Specialisation Bioprocess Engineering	apulsory pulsory pulsory sory lsory pulsory pulsory pupulsory pupulsory pory	ry
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compul General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compuls	npulsory pulsory pmpulsory sory lsory pmpulsory pmpulsory pmpulsory ory ngineering: Compulso	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (Germa	npulsory pulsory pmpulsory sory lsory pmpulsory pmpulsory ory ory ingineering: Compulso pous Mechatronics: Co	mpulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.	npulsory pulsory pmpulsory sory lsory pmpulsory pmpulsory ory ory ngineering: Compulso pcus Mechatronics: Co pcus Biomechanics: Co	mpulsory ompulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanica	npulsory pulsory pompulsory sory lsory pompulsory pompulsory ory ingineering: Compulso pocus Mechatronics: Co pocus Biomechanics: Co pocus Aircraft Systems E	mpulsory ompulsory Engineering: Compulso
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsoreral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsoreral Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsoreral Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsoreral Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Forman Engineering Science (German program, 7 semester): Specialisation Mechanical Engine	npulsory pulsory pompulsory sory lsory pompulsory pompulsory ory ingineering: Compulso pocus Mechatronics: Co pocus Biomechanics: Co pocus Aircraft Systems E	mpulsory ompulsory Engineering: Compulso



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

 $\label{thm:condition} \textbf{General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory and the state of the stat$ 

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program); Specialisation Energy and Environmental Engineering; Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Compulsory\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Mechanical\ Engineering,\ M$ 

General Engineering Science (English program, 7 semester); Specialisation Mechanical Engineering, Focus Biomechanics; Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

 $\label{thm:mechanical engineering:Core qualification:Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolf
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Manage Marketing and Sales         Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	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.

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



Module M0854: Mathematic	s IV			
- Indiana				
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential		Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential Equations) (£1045)		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	e following learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Mather	matics IV. They are able to explain them using app	opriate examples.	
	<ul> <li>Students can discuss logical connections between</li> </ul>	en these concepts. They are capable of illustrating	these connections w	ith the help of example
	<ul> <li>They know proof strategies and can reproduce the</li> </ul>	nem.		
C' '''				
Skills	Students can model problems in Mathematics IV	with the help of the concepts studied in this cours	e. Moreover, they are	capable of solving the
	by applying established methods.		, ,	3
		ogical connections between the concepts studied in	the course	
	·	•		
	For a given problem, the students can develop a	nd execute a suitable approach, and are able to cr	tically evaluate the re	esults.
Personal Competence				
•				
Social Competence	<ul> <li>Students are able to work together in teams. The</li> </ul>	y are capable to use mathematics as a common la	nguage.	
	In doing so, they can communicate new concept			can design examples
	check and deepen the understanding of their pe			oan doorgin oxampioo
	check and deepen the understanding of their pe	615.		
Autonomy				
	<ul> <li>Students are capable of checking their understand</li> </ul>	anding of complex concepts on their own. They ca	an specify open ques	tions precisely and kno
	where to get help in solving them.			
	Students have developed sufficient persistence	to be able to work for longer periods in a goal-orier	ted manner on hard	problems.
workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equa	tions 2)		
Assignment for the Following	General Engineering Science (German program): Speci	alisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speci	0 0 1 ,	nics: Compulsorv	
	General Engineering Science (German program): Speci	•		eering: Compulsory
			a woolallod Eligili	comig. Compulsory
	General Engineering Science (German program): Speci	, ,		
	General Engineering Science (German program, 7 sem	, ,	•	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engineering, Foo	us Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engineering	Focus Theoretical	Mechanical Engineerir
	Compulsory			
	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architecture: Compulsi	ory	
	Computer Science: Specialisation Computational Mathe	•	,	
	·	Mados. Ziective Compuisory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Speci-			
	General Engineering Science (English program): Specia	alisation Naval Architecture: Compulsory		
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program): Speci-	alisation Mechanical Engineering. Focus Theoretic	al Mechanical Engine	eering: Compulsorv
	General Engineering Science (English program, 7 seme	* *	-	- , ,
				mnuleon
	General Engineering Science (English program, 7 seme	, ,		
	General Engineering Science (English program, 7 se	emester): Specialisation Mechanical Engineering.	rocus Theoretical	wechanical Engineerir
	Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Naval Architecture: Compulso	ry	
	Computational Science and Engineering: Specialisation	Engineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisation			
	Mechanical Engineering: Specialisation Theoretical Me			
	Mechanical Engineering: Specialisation Mechatronics:	Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: 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	
	<ul> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

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

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

Course L1038: Complex 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
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
Mechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	The students can			
	describe the evice attendance dure used in machanical	aantayta:		
	<ul> <li>describe the axiomatic procedure used in mechanical</li> <li>explain important steps in model design;</li> </ul>	CONTEAS,		
	<ul> <li>explain important steps in model design,</li> <li>present technical knowledge.</li> </ul>			
	present technical knowledge.			
Skills	The students can			
	and the state of t	and the land of the same and the same all th	ala di ta di sa sa sa ta da d	the decree of the second
	explain the important elements of mathematical / mecl	nanical analysis and model formation, and app	ply it to the context of	tneir own problems;
	apply basic methods to engineering problems;			
	<ul> <li>estimate the reach and boundaries of the methods and</li> </ul>	d extend them to be applicable to wider proble	em sets.	
Personal Competence				
Social Competence	The students can work in groups and support each other to or	rercome difficulties.		
Autonomy	Students are capable of determining their own strengths and	weaknesses and to organize their time and le	arning based on thos	se.
		-		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisat	ion Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisat	ion Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester)	Specialisation Mechanical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester)	Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Naval Architecture: Compulso	ory	
	General Engineering Science (English program): Specialisati	on Mechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	on Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	on Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering: Com	npulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Naval Architecture: Compulso	ry	
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	$\label{thm:condition} \textbf{Technomathematics: Specialisation III. Engineering Science:}$	Elective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Complement	ary Course Core Studies: Elective Compulsor	y	

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	- Simple impact problems
	- Principles of analytical mechanics
	- Elements of vibration theory
	- Basics of continuum vibrations
	- Introduction into Modeling of Multibody Systems
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).



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

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



Module M0680: Fluid Dynai	nics			
,				
Courses				
Title		Тур	Hrs/wk	CP
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	none			
Recommended Previous	Sound knowledge of engineering mathematics, engineering med	hanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the			
	outline the rationale of flow physics using mathematical models	and are familiar with methods for the p	erformance analysis a	and the prediciton of fluid
	engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow	physics models for the analysis of techni	ical systems. The lectu	re enables the student to
	carry out all necessary theoretical calculations for the fluid dynar	nic design of engineering devices on a so	cientific level.	
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop so	lution strategies.		
Autonomy	The students are able to develop solution strategies for complex	problems self-consistent and crtically and	alyse results.	
Washing the Harry	Indexed at Ord Tax 440 Ord Tax in Late 70			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	• •	mnuleory	
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp	0 0	. ,	
	General Engineering Science (German program): Specialisation		,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		mpulsory	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			
	Computational Science and Engineering: Specialisation Engine	ering Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

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



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



Module M0640: Stochastic	s and Ship Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Ship Dynamics (L0352)		Lecture	2	3
Ship Dynamics (L1620)		Recitation Section (small)	1	1
Statistics and Stochastic Processes in Na	aval Architecure and Ocean Engineering (L0364)	Lecture	2	3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous	a Tankaisal maskarisa			
Knowledge	Technical mechanics     Linear algebra, analysis, complex numbers			
	Linear algebra, analysis, complex numbers     Fluid mechanics			
	Traid medianics			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	- The students are able to give an overview over various	manoeuvres. They can name application g	oals and they can desc	ribe the procedure of
	manoeuvres.			
	- The students are able to give an overview over varius ruc	Idor types. They can pame criteria in the rude	or design	
	- The students are able to give an overview over varius ruc	der types. They can hame chiena in the rudo	er design.	
	- The students can name computation methods which are	used to determine forces and motions in wave	es.	
01.111-	The shade decrease with the constitution of such	The state of the s	and the second the second of the second	
Skills	- The students can come up with the equations of motions which are used to discribe manoeuvres. The can use and linearise them.			
	- The students are able to determine hydrodynamic coeffic	ients and they can explain their physical mea	ning.	
	The standards are smaller to the standard and the standards are th	and the state of t		
	- The students can explain how a rudder works and they ca	an explain the physical effects which can occ	ır.	
	- The students can mathematically describe waves.			
	The state of a state o	Character to the state of the second state of	determine the con-	
	- The students can explain the mathematically description	of narmoncial motions in waves and they can	determine them.	
Personal Competence				
Social Competence	- The students can arrive at work results in groups and doc	cument them.		
	The shade decrease of the state			
	- The students can discuss in groups and explain their poin	nt of view.		
Autonomy	- The students can assess their own strengthes and weakr	nesses and the define further work steps on th	is basis.	
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Speciali	sation Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semes		ulsorv	
	General Engineering Science (English program): Specialis		,	
	General Engineering Science (English program, 7 semest		ilsory	
	Naval Architecture: Core qualification: Compulsory	- /	/	



Course L0352: Ship Dynamics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships
	Equations of motion
	Hydrodynamic forces and moments
	Linear equations and their solutions
	Full-scale trials for evaluating the maneuvering performance
	Regulations for maneuverability
	Rudder
	Seakeeping
	Representation of harmonic processes
	Motions of a rigid ship in regular waves
	Flow forces on ship cross sections
	Strip method
	Consequences induced by ship motion in regular waves
	Behavior of ships in a stationary sea state
	Long-term distribution of seaway influences
Literature	Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg
	2014
	<ul> <li>Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University of Technology, 2014</li> <li>Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United Kingdom, 2000</li> <li>Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley &amp; Sons, Canada, 1978</li> <li>Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993</li> </ul>
	<ul> <li>Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Berlin Heidelberg, Deutschland, 1992</li> <li>Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, United Kingdom, 1990</li> </ul>
	Handbuch der Werften, Deutschland, 1986
	Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001
	<ul> <li>Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability, Society of Naval Architects and Marine Engineers Jersey City, NJ, 1989</li> </ul>
	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 Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0364: Statistics and Stoch	astic Processes in Naval Architecure and Ocean Engineering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014  W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001  H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 <sup>rd</sup> 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



Module M0655: Computation	onal Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	CP
Computational Fluid Dynamics I (L0235)		Lecture	2	3
Computational Fluid Dynamics I (L0419)	D ( T	Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Mathematical Methods for Engineers			
Knowledge	Fundamentals of Differential/integral calculus and series ex	pansions		
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial differentia	I equations.		
Skills		in space and time for the governing	partial differential ed	quations. They can code
	computational algorithms in a structured way.			
Personal Competence				
Social Competence	The students can arrive at work results in groups and document the	em.		
Autonomy	The students can independently analyse approaches to solving spe	ecific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h	<del></del>		
Assignment for the Following	General Engineering Science (German program): Specialisation M		Systems: Compulsory	
Curricula	General Engineering Science (German program): Specialisation N	• •		
	General Engineering Science (German program, 7 semester): Spe-			Elective Committee
	General Engineering Science (German program, 7 semester): Spec		cus Eriergy Systems: I	Elective Compulsory
	General Engineering Science (English program): Specialisation Na General Engineering Science (English program): Specialisation Mo		veteme: Compuleon	
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec	·	-	Elective Compulsory
	Naval Architecture: Core qualification: Compulsory	anoanon meenameat Engineenity, Foc	as Energy Systems. E	icoave Compulsory
	Technomathematics: Specialisation III. Engineering Science: Electi	ve Compulsorv		
	Technomathematics: Specialisation III. Engineering Science: Electi			
	The state of the s			

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



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



Module M0659: Fundament	tals of Ship Structural Design and Analysis			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Ship Structural Design (L	0411)	Lecture	2	2
Fundamentals of Ship Structural Design (L		Recitation Section (small)	1	2
Fundamentals of Ship Structural Analysis		Lecture	2	2
Fundamentals of Ship Structural Analysis		Recitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,	•		
Knowledge	Students can reproduce the basic contents of the structural behave	iour of ship structures: they can explain	the theory and meth	ods for the calculation of
rinemeage	deformations and stresses in beam-like structures.	iour or oring outdourses, and your explain	are areary and mear	
	determinations and successor in boarn into substations.			
	Furthermore, they can reproduce the basis contents of codes (ru	lles), materials, semi-finished products,	joining and principle	es of structural design of
	components in the ship structure.			
Skills	Students are capable of applying the methods and tools for the ca	alculation of linear deformations and stre	esses in the above m	entioned structures: they
	can choose calculation models of typical ship structures.			,
	Share have a			
	Furthermore, they are capable to apply the methods of drawing a	nd sizing the ship structure; they can se	lect suitable materials	s, semi-finished products
	and joints.			
Personal Competence				
Social Competence	The students are able to communicate and cooperate in a profession	onal environment in the shipbuilding and	d component supply in	ndustry.
Autonomy	The students are capable to independently idealize real ship str	uctures and to select suitable methods	for analysis of beam	i-like structures; they are
	capable to assess the results of structural analyses.			
	Furthermore, they are capable to assess drawings of complex s	hip structures and to design ship struc	tures for various requ	uirements and boundary
	conditions.			·
Workload in Hours	Independent Study Time 156, Study Time in Lecture 84			
Credit points	8			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory			
Curricula	General Engineering Science (German program, 7 semester): Spe		orv	
ou. Hould	General Engineering Science (English program): Specialisation Na		,	
	General Engineering Science (English program, 7 semester): Spec		rv	
	Naval Architecture: Core qualification: Compulsory	Sansadon Navai Alcintecture. Compuiso	' y	
	rvavar Architecture. Core quantication: Compulsory			



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

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

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



Course L0414: Fundamentals of Ship Structural Analysis		
Тур	Recitation Section (small)	
Hrs/wk	1	
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	



Module M0664: Structural D	Design and Construction of Ships				
modalo modo ii otractarar i					
Courses					
Title		Тур	Н	rs/wk	CP
Ship Structural Design (L0412)		Lecture	2		3
Ship Structural Design (L0415)		Recitation Section	n (small) 2		3
Welding Technology (L1123)		Lecture	3		3
Module Responsible	Prof. Sören Ehlers				
Admission Requirements	None				
Recommended Previous	Mechanics I - III				
Knowledge	Fundamentals of Materials Science I - III				
	Welding Technology I				
	Fundamentals of Mechanical Design I - III				
	-				
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence					
Knowledge	Students can reproduce design and sizing as well	as fabrication of the different areas of sl	hip structures and of diffe	erent ship types	(incl. detail design);
	they can describe calculation models for complex s	tructures.			
Skills Personal Competence	Students are capable to specify the requirements suitable calculation models and to assess the chose		hull, to define design o	riteria for the c	omponents, to select
	Students are concluded a present their structural desi	ian and discuss their decisions construct	ivolvin o group		
Social Competence	Students are capable to present their structural des	ign and discuss their decisions constituct	ivery in a group.		
Autonomy	Students are capable to design independently diff methods.	erent structural areas of the ship hull a	nd different ship types a	and to define ap	propriate fabrication
Workload in Hours	Independent Study Time 172, Study Time in Lecture	98			
Credit points	9				
Examination	Written exam				
Examination duration and scale	3 hours				
Assignment for the Following	General Engineering Science (German program): S	Specialisation Naval Architecture: Compu	lsory		
Curricula	General Engineering Science (German program, 7	semester): Specialisation Naval Architec	ture: Compulsory		
	General Engineering Science (English program): S				
	General Engineering Science (English program, 7 s				
	Naval Architecture: Core qualification: Compulsory				
	womeotare. Sore quanneation. compulsory				

Course L0412: Ship Structural Design		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	SoSe	
Content	Chapters:	
	1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	



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:	
	1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	

Course L1123: Welding Technology	
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	DE
Cycle	WiSe
Content	- phase transitions, phase diagrams and thermal activated processes
	- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
	- structure and properties of non-ferrite metals (aluminum, titanium)
	- NDT/DT Methods for materials and welds
	- gas fusion welding, fundamentals of electric arc welding technologies
	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding
	- resistance welding/ polymer welding/ hybrid-welding
	- 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.



Title         Typ         Hrs/wk         CP           Resistance and Propulsion (L1265)         Lecture         2         3					
Title   Type   Hrawk   CP   Resistance and Propulsion (L1265)   Resistance and Propulsion (L1266)   Resistance Administration of the Professional Competence   Hydrostratics    Educational Objectives   The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hulliform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and value. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following lopics are dealt with:  - Stillware/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull office of the course in the prediction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, see askale), EEDI, speed frisk, contractual matters concerning speed/power, bunker claims by several progosis methods. Furtermore, the course will enable the student to clear determine and minimize the required power including environmental influences.  Personal Competence  Scial Competence  Scial Competence  Autoromy The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Horus  Independent Study Time 124, Study Time in Lecture 56  Ceredit points  Cerence Engineering Science (German program); Specialisation Naval Architectu	Module M1109: Resistance	and Propulsion			
Title   Type   Hrawk   CP   Resistance and Propulsion (L1265)   Resistance and Propulsion (L1266)   Resistance Administration of the Professional Competence   Hydrostratics    Educational Objectives   The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hulliform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and value. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following lopics are dealt with:  - Stillware/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull office of the course in the prediction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, see askale), EEDI, speed frisk, contractual matters concerning speed/power, bunker claims by several progosis methods. Furtermore, the course will enable the student to clear determine and minimize the required power including environmental influences.  Personal Competence  Scial Competence  Scial Competence  Autoromy The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Horus  Independent Study Time 124, Study Time in Lecture 56  Ceredit points  Cerence Engineering Science (German program); Specialisation Naval Architectu					
Resistance and Propulsion (L1265) Resistance and Propulsion (Lize) Resistance and Propulsion (Lize) Resistance and Propulsion (Lize) Resistance and Propulsion (Lize) Resistance and Resistance (Lize) Resistance and Propulsion (Lize) Resistance Analysis (Lize) Resistance Resistance (Lize) Resistance Resistance (Lize) Resistance Analysis (Lize) Resistance Resistance Resistance Resistance Propulsion of Propulsion of Propulsion of Propulsion of Propulsion and Propulsion of Propulsion and Propulsion of Propulsion and Propulsion of Propulsion and Propulsion and Propulsion of Propulsion and Propulsion and Propulsion Analysis (Lize) Resistance Resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for reduced flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power productions, additional resistances (wind, steering, current, sea state), EEDL speed frials, contactual matters concentring speed/power, bunker claims by several progosis methods. Furtermore, the course will enable the student to clear determine and minimize the required power including environmental influences.  Personal Competence  **Resistance**  **Resistance**  *	Courses				
Module Responsible   Port. Stefan Krüger	Title		Тур	Hrs/wk	СР
Module Responsible Admission Requirements Recommended Previous Knowledge  - Mechanics Knowledge - Fuild Dynamics for Naval Architects - Fuild Dynamics for Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory - General Engineering Science (German program): Specialisation Naval Architecture: Compulsory	Resistance and Propulsion (L1265)		Lecture	2	3
Admission Requirements Recommended Previous Knowledge  Mechanics Fluid Dynamics for Naval Architects Hydrostratics  Fluid Dynamics for Naval Architects Hydrostratics  Atter taking part successfully, students have reached the following learning results  Professional Competence Knowledge  Knowledge  The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction membrods are subject of the course. Furthermore, environmental additional resistances are dealt with:  Stillwater/added resistance, was resistance, Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminariturbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller basis, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDL speed trials, contractual matters concerning speed-power, bunker claims  The student shall learn to design competitive hull forms with respect to fue consumption by applying numerical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Social Competence  Autonomy The student learns to prepare technical matters in such a way that he can comple with his building suvervision team.  Morkload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination duration and scale  Assignment for the Following  General Engineering Scien	Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
* Mechanics * Fluid Dynamics for Naval Architects * Hydrostratics  * Educational Objectives * After taking part successfully, students have reached the following learning results  * Professional Competence * Knowledge  * Rowledge  * Frofessional Competence * Knowledge  * The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and valve. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for reducide flow separation, Appendage Design and resistance, Froude's resistance law, form factor method, thrus deduction, wake, model scaling laws, resistance tests, fere running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  **Skills**  **Personal Competence**  **Social Competence**  **Social Competence**  **Social Competence**  **Autonomy**  **Workload in Hours**  **Ine student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  **The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  **Workload in Hours**  **Workload in Hours**  **Ine student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  **Examination**  **Workload in Hours**  **Workloa	Module Responsible	Prof. Stefan Krüger			
# Mechanics Fluid Dynamics for Naval Architects After taking part successfully, students have reached the following learning results  Professional Competence Knowledge The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion are hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for reducted flow separation, Appendage Design and resistance, Froude's resistance law, form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Social Competence  Rutonomy The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Wo	Admission Requirements	None			
Educational Objectives Professional Competence Knowledge	Recommended Previous				
Educational Objectives  After taking part successfully, students have reached the following learning results  Professional Competence  Knowledge  The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law, form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furfermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Social Competence  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Independent Study Time 124, Study Time in Lecture 56  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.	Knowledge				
Educational Objectives Professional Competence Knowledge The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistances, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numerical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Social Competence  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Written exam  Examination  Written exam  Examination  Written exam  Examination duration and scale  General Engineering Science (German program		•			
Professional Competence Knowledge The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law.form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Credit points  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Spe		Hydrostratics			
The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practica applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additiona resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed fulls, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Social Competence  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  6  Examination duration and scale  Assignment for the Following  General Engineering Science (German program): Spec	Educational Objectives	After taking part successfully, students have reached the following	g learning results		
applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numerical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (Eerglish program): Specialisation Naval Architecture: Compulsory	Professional Competence				
resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/furbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, the deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Written exam  Assignment for the Following  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory	Knowledge	The hydrodynamic basics that are relevant for resistance and pr	pulsion of ships are discussed. The diff	erent resistance pheno	mena and their practical
hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		applications to hullform design as well as numerical and empirio	al prediction methods are subject of the	course. Furthermore,	environmental additional
consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination  Written exam  Examination duration and scale 180 min  Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		resistances are dealt with. The course includes model test te	chniques and their application to full s	cale ships. This hold	also for propulsion and
- Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  6  Examination  Written exam  Assignment for the Following  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		hullefficiency elements, mainly thrust deduction and wake. M	lain Focus is how hull forms can be	optimized for minimu	m and sustainable fuel
separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  **Skills**  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  **Personal Competence**  **Social Competence**  **Autonomy**  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  **Workload in Hours**  **Independent Study Time 124, Study Time in Lecture 56**  **Credit points**  **Credit points**  **Examination**  **Written exam**  Examination duration and scale**  **Examination duration and scale**  **General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  **General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		consumption. The following topics are dealt with:			
separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrus deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  **Skills**  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  **Personal Competence**  **Social Competence**  **Autonomy**  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  **Workload in Hours**  **Independent Study Time 124, Study Time in Lecture 56**  **Credit points**  **Credit points**  **Examination**  **Written exam**  Examination duration and scale**  **Examination duration and scale**  **General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  **General Engineering Science (English program): Specialisation Naval Architecture: Compulsory					
deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  Skills  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Curricula  Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		- Stillwater/added resistance, Wave resistance, Minimization of	f wave resistance, numerical prediction	methods, friction law	s, laminar/turbulent flow
predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, the			m factor method, thrust
Skills The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence Social Competence The student learns to prepare technical matters in such a way that he can compte with his building suvervision team. The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam  Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		deduction, wake, model scaling laws, resistance tests, free ru	nning propeller tests and propeller ba	sics, propulsion tests,	full scale speed power
by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		predictions, additional resistances (wind, steering, current, sea s	ate), EEDI, speed trials, contractual matte	ers concerning speed/p	ower, bunker claims
by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.  Personal Competence  Social Competence  Autonomy  The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours  Independent Study Time 124, Study Time in Lecture 56  Credit points  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Skills	The student shall learn to design competitive hull forms with res	pect to fuel consumption by applying nu	mreical techniques and	to evaluate these hulls
environmental influences.  Personal Competence Social Competence The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination Written exam  Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	S.u.ne				
Personal Competence Social Competence The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination Written exam  Examination duration and scale 180 min  Assignment for the Following General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory			nasio ino ciadoni lo ciodii delemino	4114 1111111120 1110 10	quired power morading
Social Competence Autonomy The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination Written exam  Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory					
Autonomy The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.  Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination Written exam  Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Personal Competence				
Workload in Hours Independent Study Time 124, Study Time in Lecture 56  Credit points 6  Examination Written exam  Examination duration and scale 180 min  Assignment for the Following General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  Curricula General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Social Competence	The student learns to prepare technical matters in such a way that	t he can compte with his building suverv	ision team.	
Credit points 6  Examination Written exam  Examination duration and scale 180 min  Assignment for the Following General Engineering Science (German program): Specialisation Naval Architecture: Compulsory  Curricula General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory  General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Autonomy	The student learns to prepare technical matters in such a way that	t he can compte with his building suverv	ision team.	
Examination Written exam  Examination duration and scale  Assignment for the Following Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Examination duration and scale  Assignment for the Following Curricula  Curricula  General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Credit points	6			
Assignment for the Following Curricula Curricula General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Examination	Written exam			
Curricula General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Examination duration and scale	180 min			
General Engineering Science (English program): Specialisation Naval Architecture: Compulsory	Assignment for the Following	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Naval Architecture: Compuls	sory	
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory		General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
constant Engineering Colonic (English program, 7 comocier). Openicion recent control c		General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Compuls	ory	
Naval Architecture: Core qualification: Compulsory		Naval Architecture: Core qualification: Compulsory			

Course L1265: Resistance and Prop	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 Prop	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	



Module M1118: Hydrostation	es and Body Plan			
Courses				
Title		Тур	Hrs/wk	СР
Hydrostatics (L1260)		Lecture	2	3
Hydrostatics (L1261)		Recitation Section (large)	2	1
Body Plan (L1452)		Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Good knowledge in Mathemathics I-III and Mech	nanics I-III.		
Knowledge	It is recommended that the students are familiar	with typical design relevant drawings, e.g. Body Plan, G	iA- Plan, Tank Plan etc.	
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge				
_	all following lectures in the subjects shipo desig	n and safety of ships.		•
Skills	• • •	ulations to ensure that the ship has sufficient stability. He	is able to design hull for	orms that are safe aga
	capsizing or sinking.			
Personal Competence				
Social Competence	The student gets access to hydrostatical probler	ms.		
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program	n): Specialisation Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program	n, 7 semester): Specialisation Naval Architecture: Comp	ulsory	
	General Engineering Science (English program	): Specialisation Naval Architecture: Compulsory		
	General Engineering Science (English program	, 7 semester): Specialisation Naval Architecture: Compu	ılsory	
	Naval Architecture: Core qualification: Compulsi	on		

O	
Course L1260: Hydrostatics	Lastura
Typ Hrs/wk	Lecture 2
CP	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	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
	- Equlibrium Floating Condition
	- Equlibrium Computations
	- Hydrostatic Tables and Sounding Tables
	- Trim Tables
	3. Stability at large heeling angles
	- Stability Equation
	- Cross Curves of Stability and Righting Levers
	- Numerical and Graphical Determination of Cross Curves
	- Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
	- Heeling Moments of Different Type
	- Balance of Heeling and Righting Moments acc. to BV 1030
	- Intact Stability Code (General Critaria)
	4. Linearization of Stability Problems
	- Linearization of Restoring Forces and Moments
	[161]



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



Module M1110: Ship Design	n			
0				
Courses				
Title		Тур	Hrs/wk	CP
Ship Design (L1262) Ship Design (L1264)		Lecture Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger	Trooleation occiton (large)	2	-
Admission Requirements	None			
Recommended Previous				
Knowledge	Fluid Dynamics for Naval Architects, Resistance and Propulsion     Resistance and Propulsion, Hydrostatics			
Educational Objectives	After taking part successfully, students have reached the following learn	ning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the importance and require thoroughly discussed. Typical building contracts and the related technitroduced and their influence on the competitiveness of a design. The performance of a ship design and the consecutive process elements. The student shall further learn to model complex systems properly so the The lecture continues with an introduction into the different phases of deare introduced to generate building specification relevant information of following topics are adressed:	nnical risk are introduced. The r ne lecture focusses on the influe In this lecture, the design change at the relavent technical conclusions esign project, from the initial design	most important main pa nce of alternated main es are dealt with by sim ons can be drawn. In phase to a building co	trameters of a ship ar parameters on the tota ple models or formulae ontract. Further, method
	- Structure of a building specification - Determination of Light Ship Weight and Deadweight Components - Design of main section and hull form - Design of aftbody lines and manoevering devices - Design of main propulsion plant - Design of subdivision - Determination of limiting GMrequ- Curves - Scantlings of most improtant structural members - Longitudinal strength - Outfitting Components - Relevant rules and regulations			
Skills	The student is made familiar with the basic design principles of seage carry out a concept design based on a vessel of comparison fulfilling ty the basic design methods to determine the fundamantal technical chavalues. Based on the lecture "Principles of Ship Design" the relevant methods.	pical contract requirements within racteristics of a ship design with	the Marine Environment respect to fulfillment pro	nt. The lecture deals wit ocedures of the contra
Personal Competence				
Social Competence	The students learns to prepare technical matters in such a way the he c	an persuade his potantial custome	er against his competito	rs.
Autonomy	The students learns to prepare technical matters in such a way the he c	an persuade his potantial custome	er against his competito	rs.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Naval	Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialist		sorv	
General Engineering Science (German program): Specialisation Naval Architecture: Compulsory			oo.,	
	General Engineering Science (English program, 7 semester): Specialisation Navari		sorv	
	Naval Architecture: Core qualification: Compulsory	a reavai / ironiteoture. Oompuis	,	
	The state of the s			

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	



## **Specialization Bioprocess Engineering**

Biotechnology provides the basics for sustainable manufacturing of products as food, feed, bioenergy, biopolymers and chemicals and for providing the human being wit medicines and other essential goods. It requires interdisciplinary application of natural (especially biology and chemistry) and engineering sciences. Many everyday products are manufactured by means of biotechnical production processes. Biotechnical material conversion is also used to utilize and minimize byproducts and residues in order to achieve sustainable production. Engineers with biotechnical expertise are needed to meet the growing global demand for the development and operation of biotechnical processes by which to manufacture essential everyday products.

Graduates can explain phenomena that occur in bioprocess engineering and allied disciplines. They can outline the basic bioprocess engineering principles for interpreting, modeling, and simulating biological processes and chemical reactions, energy, material, and momentum transport processes, micro-, meso- and macro-scale separation processes, and for operating the plant required for these processes. They are able to describe the basics of measurement and control technology. They can take into consideration legal aspects that arise in connection with process engineering and production facilities.

Courses			
ïtle		Тур	Hrs/wk CP
Introduction into Process Engineering/Bioprocess Engineering (L0829)		Lecture	2 1
undamentals of material engineering (L08	330)	Lecture	2 2
Module Responsible	Prof. Michael Schlüter		
Admission Requirements	none		
Recommended Previous	none		
Knowledge			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results	
Professional Competence			
Knowledge	After passing this module the students have the ab	ility to:	
	give an overview of the most important field	Is on process and bioprocess engineering	
	explain some working methods for different		
		· · · · · · · · · · · · · · · · · · ·	
Skills	After passing this module the students should have	e the ability to:	
	<ul> <li>list and outline the most important fields of</li> </ul>	process engineering,	
	<ul> <li>name the most important working approaches or methods of the different fields of process engineering,</li> </ul>		
	read and prepare an engineering drawing,		
	explain the most important technologies for wastewater and exhaust air treatment		
		ical processes independently with the aid of pointe	rs.
Personal Competence			
Social Competence	The students are able to		
	<ul> <li>work out results in groups and document th</li> </ul>	em,	
		eedback on their own performance constructively.	
		,	
Autonomy	The students are able to estimate their progress	s of learning by themselves and to deliberate the	eir lack of knowledge in Process Engineerin
	Bioprocess Engineering.		
Workload in Hours	Independent Study Time 34, Study Time in Lecture	56	
Credit points	3		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following	General Engineering Science (German program):	Specialisation Process Engineering: Compulsory	
Curricula	General Engineering Science (German program):		ry
		semester): Specialisation Process Engineering: C	
	General Engineering Science (German program, 7		
	Bioprocess Engineering: Core qualification: Comp		. ,
	General Engineering Science (English program): S		У
	General Engineering Science (English program): S		-
	General Engineering Science (English program, 7		ompulsory
	General Engineering Science (English program, 7		
	Process Engineering: Core qualification: Compulsi		• •



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

Course L0830: Fundamentals of ma	
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	<ul> <li>Introduction</li> <li>Atomic structure and bonding</li> <li>Structure of solids</li> <li>Miller indices</li> <li>Imperfections in solids</li> <li>Texture</li> <li>Diffusion</li> <li>Mechanical properties</li> <li>Dislocations and strengthening mechanisms</li> <li>Phase transformations</li> <li>Phase diagrams, iron-carbon phase diagram</li> <li>Metallic materials</li> <li>Corrosion</li> <li>Polymeric materials</li> </ul>
Literature	<ul> <li>Ceramic materials</li> <li>Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012.</li> <li>Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009.</li> <li>Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008.</li> <li>Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflag Weinheim, Wiley-VCH, 2013.</li> <li>Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.</li> </ul>



Module M0937: Physical Cl	nemistry			
Courses				
Title		Тур	Hrs/wk	CP
Physical Chemistry (L0833) Physical Chemistry (L0835)		Lecture  Laboratory Course	2	2
Module Responsible	Prof. Hans-Ulrich Moritz	Laboratory Course	2	'
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemistry, physics for	r engineers and mathematics I-III		
Knowledge	Comento of the previous modules mergame enemistry, physics is	r engineers and matternation in.		
Educational Objectives	After taking part successfully, students have reached the following	a learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , , ,	5 · · · · · · · · · · · · · · · · · · ·		
Knowledge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-, $ h $	eat- and momentum transfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.			
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and l	inetic calculations.		
	- assess new applications with respect to environmental sustain	ability.		
	- abstract their knowldege to related issues to conduct thermodyl	amical, electrochemical and kinetic ca	Iculations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document e	periments according to scientific guide	elines in small groups.	
	The students are able to reflect their subject-specific knowledge	orally in a team and to discuss it with fe	llow students and faculty	<i>'</i> .
Autonomy	Students are able to assess their knowldege continuously on the	ir own by exemplified practice. Studen	nts are able to apply thei	r knowldege discretely to
	plan, prepare and conduct experiments.	,		,
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation		nnulcon	
	General Engineering Science (German program, 7 semester): Sp			
	Bioprocess Engineering: Core qualification: Elective Compulsor		osavo oompulaory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		npulsory	
	General Engineering Science (English program, 7 semester): Sp			
	Process Engineering: Core qualification: Compulsory			

Course L0833: Physical Chemistry	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of
	chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces
Literature	P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013
	P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008
	G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012
	R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993
	U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011
L	



Course L0835: Physical Chemistry	
Тур	Laboratory Course
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
	Reaction kinetics
	Freezing-point depression (cryoscopy)
	Electrical mobility of ions
	Viscosimetry
	Heat of neutralization
	Surface tension
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Module M0536: Fundament	tals of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Fluid Mechanics (L0091) Fluid Mechanics for Process Engineering		Lecture Recitation Section (large)	2	4
Module Responsible		rissialist ession (align)		
· · · · · · · · · · · · · · · · · · ·	None			
Admission Requirements Recommended Previous	Notice			
Knowledge	Mathematics I+II+III			
Knowledge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	Simplification and solving of partial differential equations			
	Integration			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	The taking part decession, state in the reading are in the initial	Todaming Todamo		
Knowledge	Students are able to:			
, and medge				
	explain the difference between different types of flow			
	<ul> <li>give an overview for different applications of the Reynolds</li> </ul>	Transport-Theorem in process engineer	ring	
	<ul> <li>explain simplifications of the Continuity- and Navier-Stoke</li> </ul>	s-Equation by using physical boundary of	conditions	
Skills	The students are able to			
	describe and model incompressible flows mathematically			
	<ul> <li>reduce the governing equations of fluid mechanics by sim</li> </ul>		ns e.g. by integration	
	notice the dependency between theory and technical app			
	<ul> <li>use the learned basics for fluid dynamical applications in f</li> </ul>	elds of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from subject related, pro			
	able to work together on subject related tasks in small gro	ups. They are able to present their result	ts effectively in English	(e.g. during small gro
	exercises)  • are able to work out solutions for exercises by themselves	to discuss the solutions orally and to pr	ocant the recults	
	are able to work out solutions for exercises by themselves	to discuss the solutions orally and to pre	esent the results.	
Autonomy	The students are able to			
	a govern further literature for each tonic and to expand their	recorded as with this literature		
	<ul> <li>search further literature for each topic and to expand their</li> <li>work on their exercises by their own and to evaluate their</li> </ul>			
	work on their exercises by their own and to evaluate their	ctual knowledge with the leedback.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation	Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Energy and Enviromental Engineering: C	Compulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Bioprocess Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Energy and Enviromental Er	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): Specialisation E	ioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation E	nergy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (English program): Specialisation F			
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe	, , , , ,		
	General Engineering Science (English program, 7 semester): Spe	••	gineering: Compulsory	•
	Technomathematics: Specialisation III. Engineering Science: Elec	tive Compulsory		
	Process Engineering: Core qualification: Compulsory			



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

Course L0092: Fluid Mechanics 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	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007</li> <li>Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin,</li> </ol>
	Heidelberg, 2008  10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006  11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.  12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011



Module M0757: Biochemist	ry and Microbiology			
Courses				
Title		Тур	Hrs/wk	CP
Biochemistry (L0351)		Lecture	2 2	2
Biochemistry (L0728)		Problem-based Learning	1	1
Microbiology (L0881)		Lecture	2	2
Viicrobiology (L0888)		Problem-based Learning	1	1
Module Responsible	Dr. Paul Bubenheim	<u> </u>		
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical researc	h to determine the properties of biomolecules		
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Chille				
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	n discussions in teams		
	- to divide a complex task into subtasks, solve these and to p	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			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Bioprocess Engineering: Compulsory	·	·
Curricula	General Engineering Science (German program, 7 semeste	r): Specialisation Bioprocess Engineering: Cor	npulsory	
	Bioprocess Engineering: Core qualification: Compulsory	•	•	
	General Engineering Science (English program): Specialisa	tion Bioprocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester		pulsory	
	Technomathematics: Specialisation III. Engineering Science			



Course L0351: Biochemistry		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Paul Bubenheim	
Language	DE	
Cycle	SoSe	
Content	1. The molecular logic of Life 2. Biomolecules: 1. Amino acids, peptides, proteins	
	2. Carbohydrates 3. Lipids 3. Protein functions, Enzymes: 1. Michaelis-Menten kinetics 2. Enzyme regulation 3. Enzyme nomenclature 4. Cofactors and cosubstrates, vitamines 5. Metabolism: 1. Basic principles 2. Photosynthesis 3. Glycolysis 4. Citric acid cycle 5. Respiration 6. Anaerobic respirations 7. Fatty acid metabolism 8. Amino acid metabolism	
Literature	Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn, Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin	

Course L0728: Biochemistry	
Тур	Problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0881: Microbiology	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	The procaryotic cell     evolution
	taxonomy and specific properties of Archaea, Bacteria, and viruses
	structure and properties of the cell
	• growth
	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/

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



Module M0544: Phase Equi	ilibria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	СР
Thermodynamics III (L0114)		Lecture	2	2
Thermodynamics III (L0140)		Recitation Section (small)	1	2
Thermodynamics III (L0142)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Thermodynan	nics I and II		
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria.</li> <li>They learn how state variables are influenced by the mixing of compounds and learn concepts to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor liquid, solid) coexist in equilibrium. Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	simplify these equations meaningfully.  The students know models which can be resulting mathematical relations.  For specific applications, they are able to literature sources.  Beside pure compound properties the st.  The students know how to visualize phase	are able to identify the correct equation for the determine e used to determine the properties of the system in the conself-reliantly find necessary physico-chemical properties udents are capable of describing the properties of mixture se equilibria graphically and they know how to interpret this are able to understand fundamental concepts that an	equilibrium state and the soft compounds as well as.	they are able to solve the
Personal Competence Social Competence Autonomy	The students are able to find necessary in	o solve the corresponding problems and to present them on formation self-reliantly in literature sources and to judge the check their learning progress continuously in exerci	their quality.	
Workload in Hours	Independent Study Time 124, Study Time in Lec	eture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculation			
Assignment for the Following		n): Specialisation Process Engineering: Compulsory		
Curricula		n): Specialisation Bioprocess Engineering: Compulsory		
		n, 7 semester): Specialisation Process Engineering: Comp		
	General Engineering Science (German program	n, 7 semester): Specialisation Bioprocess Engineering: Co	mpulsory	
	Bioprocess Engineering: Core qualification: Con	mpulsory		
	General Engineering Science (English program)	): Specialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program)	): Specialisation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program,	, 7 semester): Specialisation Process Engineering: Comp	ulsory	
		, 7 semester): Specialisation Process Engineering: Comp , 7 semester): Specialisation Bioprocess Engineering: Co	•	



Course L0114: Thermodynamics III	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	
	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics Cambridge University Press, 2005.</li> </ul>

Course L0140: Thermodynamics III	
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	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure  The students work on tasks in small groups and present their results in front of all students.
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>



Course L0142: Thermodynamics III	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>



ourses				
itle		Тур	Hrs/wk	СР
gnals and Systems (L0432)		Lecture	3	4
gnals and Systems (L0433)		Recitation Section (large)	1	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 syste	ms. Good knowledge in maths as covere	d by the moduls Mat	hematik 1-3 is exped
	Further experience with spectral transformations (Fourier series,			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear			
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain.		in time domain and i	mage domain which
OL III.	caused by the transition of a continuous-time signal to a discrete		and the standard followed	
Skills	The students are able to describe and analyse deterministic sig	•	-	
	can analyse and design basic systems regarding important pro the impact of LTI systems on the signal properties in time and fre		oonse, stability, ilnear	ny etc They can as
Personal Competence	the impact of E it systems on the signal properties in time and he	quency domain.		
Personal Competence Social Competence	The students can jointly solve specific problems			
Social Competence Autonomy	The students can jointly solve specific problems.  The students are able to acquire relevant information from any	ronriate literature cources. Thou can cont	rol their level of know	rledge during the les
Autonomy	The students are able to acquire relevant information from app period by solving tutorial problems, software tools, clicker system		ioi liieii level Ol KIIOW	reage during the let
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
•				
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		mnulsorv	
	General Engineering Science (German program): Specialisation		mpaisory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): S		ulsory	
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S	pecialisation Process Engineering: Compu	ilsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foo	cus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foo	cus Energy Systems: 0	Compulsory
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compuls
	General Engineering Science (German program, 7 semester	: Specialisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foo	us Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering	Focus Theoretical N	Mechanical Enginee
	Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory	ON The state of th	and the same	
	General Engineering Science (English program): Specialisation		npulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		ulsory	
	General Engineering Science (English program, 7 semester): Sp		•	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Process Engineering: Compu	Isory	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foc	us Biomechanics: Co	mpulsory
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foc	us Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foc	us Aircraft Systems Er	ngineering: Compuls
	General Engineering Science (English program, 7 semester	: Specialisation Mechanical Engineering	, Focus Materials in	Engineering Scier
	Compulsory			
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester)	Specialisation Mechanical Engineering	Focus Theoretical M	Mechanical Enginee
	Compulsory			
	Computational Science and Engineering: Core qualification: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



ourses				
ourses				
tle		Typ	Hrs/wk	СР
troduction to Management (L0880)		Typ Lecture	3	3
oject Entrepreneurship (L0882)		Problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	Dasio Miowicogo of Mathematics and Dasiness			
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence	The making part occoording, cacome nate to action and the length of	- Imig roodito		
Knowledge	After taking this module, students know the important basics of many	different areas in Rusiness and Ma	nagement from Plani	ning and Organisation
runomougo	Marketing and Innovation, and also to Investment and Controlling. In p		nagomoni, nom r iam	mig and Organication
	explain the differences between Economics and Management	and the sub-disciplines in Managem	ent and to name impo	rtant definitions from
	field of Management			
	explain the most important aspects of and goals in Manageme			
	describe and explain basic business functions as production		chain management, o	rganization and hum
	ressource management, information management, innovation	•		
	explain the relevance of planning and decision making in B	isiness, esp. in situations under mu	iltiple objectives and	uncertainty, and expl
	some basic methods from mathematical Finance	in a manufactural a		
	state basics from accounting and costing and selected control	ng methods.		
Skills	Students are able to analyse business units with respect to d	fferent criteria (organization, object	ctives, strategies etc.	) and to carry out
	Entrepreneurship project in a team. In particular, they are able to			
	A section Management and a section to the section of the section o			
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies	and a constant and constant and a constant		
	<ul> <li>apply methods for decision making under multiple objectives,</li> <li>analyse production and procurement systems and Business in</li> </ul>			
	<ul> <li>analyse production and procurement systems and Business ir</li> <li>analyse and apply basic methods of marketing</li> </ul>	offilation systems		
	select and apply basic methods from mathematical finance to	predefined problems		
	apply basic methods from accounting, costing and controlling			
	apply sadio memode norm associating, seeding and controlling	y prodomica 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 entrepreneursh	in project and write a coherent repor	t on the project	
	to communicate appropriately and	p project and write a concretit report	ton the project	
	to cooperate respectfully with their fellow students.			
	to cooperate respectantly was their follow electric.			
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.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Elec	rical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Com	puter Science: Compulsory		
	General Engineering Science (German program): Specialisation Prod	ess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biop	ocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy	gy and Enviromental Engineering: C	ompulsory	
	$\label{thm:continuous} \textbf{General Engineering Science (German program): Specialisation Civil}$	and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Mec	anical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bion	edical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Nav			
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	sation Process Engineering: Compu	ılsory	
	General Engineering Science (German program, 7 semester): Specia	•		
	General Engineering Science (German program, 7 semester): Specia	•	•	
	General Engineering Science (German program, 7 semester): Specia	·	-	
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	-		
	General Engineering Science (German program, 7 semester): Specia	-	-	
	General Engineering Science (German program, 7 semester): Sp	cialisation Mechanical Engineering	g, Focus Materials in	Engineering Science
l				
	Compulsory General Engineering Science (German program, 7 semester): Spe			



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program); Specialisation Biomedical Engineering; Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program); Specialisation Process Engineering; Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Mana	gement	
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. Wolfgan	
Lecturer	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales         Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	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.	

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



Courses				
Title		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (	L0841)	Lecture	2	3
Bioprocess Engineering- Fundamentals (L		Recitation Section (large)	2	1
Bioprocess Engineering - Fundamental Pr		Laboratory Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	none			
Recommended Previous	none, module "organic chemistry", module "fundamentals fo	process engineering"		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	Students are able to describe the basic concepts of biop	ocess engineering. They are able to classif	y different types of k	kinetics for enzymes
	microorganisms, as well as to differentiate different types of	inhibition. The parameters of stoichiometry an	d rheology can be na	amed and mass trans
	processes in bioreactors can be explained. The students	are capable to explain fundamental bioproce	ss management, ste	rilization technology
	downstream processing in detail.			
Skilla	After successful completion of this module, students should	an able to		
Skills	Alter succession completion of this module, students should	e able to		
	<ul> <li>describe different kinetic approaches for growth and</li> </ul>	substrate-uptake and to calculate the correspo	nding parameters	
	<ul> <li>predict qualitatively the influence of energy generation</li> </ul>	n, regeneration of redox equivalents and grow	th inhibition on the fe	ermentation process
	<ul> <li>analyze bioprocesses on basis of stoichiometry and</li> </ul>	o set up / solve metabolic flux equations		
	<ul> <li>distinguish between scale-up criteria for different bio</li> </ul>	reactors and bioprocesses (anaerobic, aerobic	as well as microaer	obic) to compare then
	well as to apply them to current biotechnical problem			
	<ul> <li>propose solutions to complicated biotechnological p</li> </ul>	oblems and to deduce the corresponding mod	els	
	to explore new knowledge resources and to apply th			
	identify scientific problems with concrete industrial us			
	<ul> <li>to document and discuss their procedures as well as</li> </ul>	results in a scientific manner		
Personal Competence				
Social Competence	After completion of this module participants should be able	to debate technical questions in small teams	to enhance the abilit	ty to take position to t
	own opinions and increase their capacity for teamwork in en	gineering and scientific environments.		
Autonomy	After completion of this module participants will be able to	solvo a tochnical problem in a team indepe	andontly by organizi	ag thair workflow and
Autonomy	present their results in a plenum.	solve a technical problem in a team indepe	midently by organiza	ig their workhow and
	present their results in a pienum.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa	tion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semeste	): Specialisation Process Engineering: Compu	lsory	
	General Engineering Science (German program, 7 semeste	): Specialisation Bioprocess Engineering: Con	npulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisa	tion Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisa	tion Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester	: Specialisation Process Engineering: Compu	sory	
	General Engineering Science (English program, 7 semester	: Specialisation Bioprocess Engineering: Com	ipulsory	
	Biomedical Engineering: Specialisation Artificial Organs and		-	
	Biomedical Engineering: Specialisation Implants and Endop			
	Biomedical Engineering: Specialisation Medical Technology			
	Biomedical Engineering: Specialisation Management and B			
	Technomathematics: Specialisation III. Engineering Science	' '		



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

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

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



Module M0538: Heat and M	lass Transfer			
Courses				
Title		Тур	Hrs/wk 2	CP
Heat and Mass Transfer (L0101) Heat and Mass Transfer (L0102)		Lecture 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	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students are capable of explaining qualitative as	nd determining quantitative heat transfer in	procedural apparatu	s (e. g. heat exchange
	chemical reactors).			
	They are capable of distinguish and characterize diffe	rent kinds of heat transfer mechanisms name	ly heat conduction, I	neat transfer and therma
	radiation.			
	The students have the ability to explain the physical base.	asis for mass transfer in detail and to describe	mass transfer quali	tative and quantitative b
	using suitable mass transfer theories.			
	They are able to depict the analogy between heat- and	I mass transfer and to describe complex linked	d processes in detail	
Skills	The students are able to set reasonable system bour	ndaries for a given transport problem by usin	in the gained knowle	edge and to halance th
	corresponding energy and mass flow, respectively.	idanes for a given transport problem by dain	ig the gamed known	sage and to balance in
	They are capable to solve specific heat transfer prob	lems (e.g. heated chemical reactors, tempera	ature alteration in flu	ids) and to calculate th
	corresponding heat flows.	, ,		,
	Using dimensionless quantities, the students can execute	ute scaling up of technical processes or appa	ratus.	
	They are able to distinguish between diffusion, converge.	ective mass transition and mass transfer. The	y can use this know	ledge for the descriptio
	and design of apparatus (e.g. extraction column, rectification)	cation column).		
	In this context, the students are capable to choose		I mass exchanger f	or a specific applicatio
	considering their advantages and disadvantages, resp			
	In addition, they can calculate both, steady-state and n  The students are exceptle to connect their knowled			In particular the course
	<ul> <li>The students are capable to connect their knowled thermodynamics, fluid mechanics and chemical process</li> </ul>			iii pariicular ille course
	and one made process	originating, to corre concrete teaminal pro	55.66.	
Personal Competence				
Social Competence	The standard constitution of the standard con	de la companya de la		ht.
	<ul> <li>The students are capable to work on subject-specific of other students.</li> </ul>	challenges in teams and to present the result	s orally in a reasona	ble manner to tutors an
	other students.			
Autonomy				
, identify	The students are able to find and evaluate necessary i	nformation from suitable sources		
	They are able to prove their level of knowledge du		dure continuously (d	clicker-system, exam-lik
	assignments) and on this basis they can control their le	earning processes.		
*** ** ** **	Laterated Out To 100 O			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination Examination duration and scale	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations	on Process Engineering Community		
Assignment for the Following  Curricula	General Engineering Science (German program): Specialisati General Engineering Science (German program): Specialisati			
Curricula	General Engineering Science (German program): Specialisati General Engineering Science (German program): Specialisati		mpulsorv	
	General Engineering Science (German program, 7 semester):	• •		
	General Engineering Science (German program, 7 semester):		-	
	General Engineering Science (German program, 7 semester):			у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	on Energy and Environmental Engineering: Co	mpulsory	
	General Engineering Science (English program): Specialisation	on Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):		•	
	General Engineering Science (English program, 7 semester):		•	
	General Engineering Science (English program, 7 semester):		neering: Compulsor	/
	Technomathematics: Specialisation III. Engineering Science: I	=lective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Process Engineering: Core qualification: 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	1. 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
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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



Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141) Separation Processes (L1159)  Module Responsible Prof. Irina Smirnova  Admission Requirements Recommended Previous Knowledge  Educational Objectives Professional Competence Knowledge  • The students can distinguish and describe different types of separation processes such as distillation, extract • The students develop an understanding for the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process.	2 2 1	CP 2 2 1
Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141) Separation Processes (L0141) Separation Processes (L0141) Separation Processes (L0141) Separation Processes (L1159)  Module Responsible Admission Requirements Recommended Previous Knowledge  Recommended Previous After taking part successfully, students have reached the following learning results  Professional Competence Knowledge  • The students can distinguish and describe different types of separation processes such as distillation, extraction of the course of concentration during a separation process, the set of the students develop an understanding for the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of concentration during a separation process, the set of the students develop and the course of the course o	2 2 1	2 2 1
Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141) Separation Pr	2	2
Thermal Separation Processes (L0141) Separation Processes (L0141) Separation Processes (L1159)  Module Responsible Admission Requirements Recommended Previous Knowledge  Educational Objectives Professional Competence Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extract the following of the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process.	1	1
Separation Processes (L1159)   Prof. Irina Smirnova   Admission Requirements   None   Recommended Previous   Knowledge   After taking part successfully, students have reached the following learning results   Professional Competence   Knowledge   The students can distinguish and describe different types of separation processes such as distillation, extract   The students develop an understanding for the course of concentration during a separation process, the state of the students develop an understanding for the course of concentration during a separation process, the state of the students develop an understanding for the course of concentration during a separation process, the state of the students develop an understanding for the course of concentration during a separation process, the state of the students develop an understanding for the course of concentration during a separation process, the state of the students develop an understanding for the course of concentration during a separation process, the state of the state o		-
Module Responsible Prof. Irina Smirnova  Admission Requirements None  Recommended Previous Knowledge  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence Knowledge  • The students can distinguish and describe different types of separation processes such as distillation, extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process, the extraction of the students develop and understanding for the course of concentration during a separation process.	1	1
Admission Requirements Recommended Previous Knowledge  Educational Objectives Professional Competence Knowledge  • The students can distinguish and describe different types of separation processes such as distillation, extrace • The students develop an understanding for the course of concentration during a separation process, the extractions are processed in the students develop an understanding for the course of concentration during a separation process, the extraction is separation process.		
Recommended Previous Knowledge  Educational Objectives Professional Competence Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process, the extraction of the course of concentration during a separation process.		
Knowledge  Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence  Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process.		
Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence  Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extraction to the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process, the extraction of the students develop an understanding for the course of concentration during a separation process.		
Professional Competence  Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extrace The students develop an understanding for the course of concentration during a separation process, the e	_	
Professional Competence  Knowledge  The students can distinguish and describe different types of separation processes such as distillation, extrace The students develop an understanding for the course of concentration during a separation process, the e		
Knowledge     The students can distinguish and describe different types of separation processes such as distillation, extrace     The students develop an understanding for the course of concentration during a separation process, the e		
<ul> <li>The students can distinguish and describe different types of separation processes such as distillation, extrace</li> <li>The students develop an understanding for the course of concentration during a separation process, the extraction of the course of concentration during a separation process.</li> </ul>		
process, the possibilities of energy saving, and the selection of separation systems  They have good knowledge of designing methods for separation processes and devices		
energy and material balances  The students can use different graphical methods for the designing of a separation process and define the an They can select and design a basic type of thermal separation process for a given case based on the an process  The students are capable to obtain independently the needed material properties from appropriate sources ( They can calculate continuous and discontinuous processes  The students are able to prove their theoretical knowledge in the experimental lab work.  The students are able to discuss the theoretical background and the content of the experimental work with the	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associated energy and material balances</li> <li>The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required</li> <li>They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables)</li> <li>They can calculate continuous and discontinuous processes</li> <li>The students are able to prove their theoretical knowledge in the experimental lab work.</li> <li>The students are able to discuss the theoretical background and the content of the experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems.</li> </ul>	
<ul> <li>The students are able to carry out practical lab work in small groups and organize a functional division of ladiscuss their results and to document them scientifically in a report.</li> </ul>	<ul> <li>The students can work technical assignments in small groups and present the combined results in the tutorial</li> <li>The students are able to carry out practical lab work in small groups and organize a functional division of labor between them. They are able to discuss their results and to document them scientifically in a report.</li> </ul>	
The students can proof the state of their knowledge with exam resembling assignments and in this way contribute.	<ul> <li>The students are capable to obtain the needed information from suitable sources by themselves and assess their quality</li> <li>The students can proof the state of their knowledge with exam resembling assignments and in this way control their learning process</li> </ul>	
Workload in Hours Independent Study Time 96, Study Time in Lecture 84		
Credit points 6		
Examination Written exam		
Examination duration and scale 120 minutes; theoretical questions and calculations	120 minutes; theoretical questions and calculations	
Assignment for the Following General Engineering Science (German program): Specialisation Process Engineering: Compulsory		
Curricula General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory		
General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsor	ory	
General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering	g: Compulsory	
Bioprocess Engineering: Core qualification: Compulsory		
Energy and Environmental Engineering: Core qualification: Compulsory		
General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory		
General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsor	ry	
General Engineering Science (English program): Specialisation Process Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory		



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	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	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie</li> </ul>



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



Course L0141: Thermal Separation	Processes
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	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	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie</li> </ul>



Course L1159: Separation Process	es
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Compulsory attendence of the colloquia of all experiments and compulsory report.
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	SoSe
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the
Content	students explain and discuss the theoretical background and its translation into practice with staff and fellow students.
	State of the displace and displace and the state of the s
	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     Living Consortion Proposed McConv. Little 2. Avril 4000.
	<ul> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> </ul>
	J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
	Mersmann: Thermische Verfahrenstechnik, Springer, 1980
	Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
	Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff,
	Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.
	R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
	Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s
	Enzyklopädie der Technischen Chemie



Module M0892: Chemical R	eaction Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fundame	ntals) (L0204)	Lecture	2	2
Chemical Reaction Engineering (Fundame	ntals) (L0244)	Recitation Section (large)	2	2
Experimental Course Chemical Engineerin	g (Fundamentals) (L0221)	Laboratory Course	2	2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules mathematics I-III, phys	ical chemistry, technical thermodynamics I+II as w	rell as computational r	nethods for engineers.
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of chem	nical reaction engineering. They are able to point	out differences betwe	en thermodynamical and
	kinetical processes. The students have a strong ability to			
Skills	After successful completion of the module, students are a	able to:		
	- apply different computational methods to dimension isc	thermal and non-isothermal ideal reactors,		
	- determine and compute stable operation points for thes	se reactors ,		
	- conduct experiments on a lab-scale pilot plants and do	cument these according to scientific guidelines.		
Personal Competence				
Social Competence	After successful completition of the lab-course the stud	ents have a strong ability to organize themselfe	s in small groups to	solve issues in chemica
	reaction engineering. The students can discuss their sub	ject related knowledge among each other and wi	th their teachers.	
Autonomy	The students are able to obtain further information and	assess their relevance autonomously. Students	can apply their know	dege discretely to plan
	prepare and conduct experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specia	alisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specia	alisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 seme	ester): Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 seme	ester): Specialisation Bioprocess Engineering: Co	mpulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specia	llisation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specia	llisation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Specialisation Process Engineering: Compu	ılsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Bioprocess Engineering: Cor	npulsory	
	Process Engineering: Core qualification: Compulsory			

ourse L0204: Chemical Reaction Engineering (Fundamentals)	
Typ L	Lecture
Hrs/wk 2	2
CP 2	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer F	Prof. Raimund Horn
Language [	DE
Cycle	WiSe
8	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, incand solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, maconcentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversionally, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
c	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relative between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
t t t t t t	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynam temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, stand heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law 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 react systems, Lagrange Multipliers)
r e e e e e e e e e e e e e e e e e e e	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechani microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pexponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integrated 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, relimiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex reactions.



single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

## Literature

lecture notes Raimund Horn

skrint 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
- $\hbox{H.\,S.\,Fogler,\,Essentials\,of\,Chemical\,\,Reaction\,\,Engineering,\,Prentice\,\,Hall}$
- 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
- $\hbox{M.\,E.\,Davis,\,R.\,J.\,Davis,\,Fundamentals\,of\,Chemical\,\,Reaction\,\,Engineering,\,McGraw\,\,Hill}$
- 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



ırse L0244: Chemical Reaction E	Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer Language	Prof. Raimund Horn, Dr. Oliver Korup DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, iner
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mas 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, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relative 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 thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standar heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemic 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 mechanis microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pr exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integr method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, ralimiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactor single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stage reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flor reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mol balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exotherm reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of t cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isotherm 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
i	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker  R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000



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



OUROO				
ourses		T	Here fords	0.0
tle	17)	Тур	Hrs/wk	<b>CP</b> 4
oprocess Engineering - Advanced (L110 oprocess Engineering - Advanced (L110		Lecture Recitation Section (small)	2	2
Module Responsible	Prof. An-Ping Zeng			
Admission Requirements	none			
Recommended Previous	Content of module "Biochemical Engineering I"			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	After successful completion of this module, students should be a	able to		
	<ul> <li>describe and explain different kinetic approaches for group</li> </ul>	with and substrate untake		
	describe and explain unlerent kinetic approaches for gro	owiii aliu subsitate-uptake		
	<ul> <li>identification of scientific problems with concrete industr</li> </ul>	rial use (cultivation of microorganisms and r	nammalian cells)	
	<ul> <li>describe and explain important downstreaming steps for</li> </ul>	r proteins and their application as well as b	asic immobilization m	ethods
Skills	After successful completion of this module, students should be a	able to		
	- to identifiy scientific questions or possible practical problems	for concrete industrial applications (eg cu	Itivation of microorga	nisms and animal cel
	and to formulate solutions,	селосто постоя предоставания (од се		
	- To assess the application of scale-up criteria for different type	s of bioreactors and processes and to appl	y these criteria to give	en problems (anaerob
	aerobic or microaerobically)			
	- to formulate questions for the analysis and optimization of real	biotechnological production processes app	propriate solutions,	
	- To describe the effects of the energy generation, the regenera	tion of reduction equivalents, and the grow	th inhibition of the hel	navior of microorganie
	and to the total fermentation process qualitatively	and the grow		avior or microorgams
	Fatablish anatorial flour balance according and calus there to	determine the biretic researchers of differen		
	- Establish material flow balance equations and solve them to and activity yields ,	determine the kinetic parameters of differen	nt approaches and to	calculate immobilizat
	and activity yields ,			
	- to select process control strategies (batch , fed-batch , continui	ity ) appropriately and to calculate basic type	es and evaluate them	1.
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Personal Competence				
Social Competence	After completion of this module participants should be able to	debate technical questions in small teams	to enhance the ability	y to take position to th
	own opinions and increase their capacity for teamwork.			
Autonomy	After completion of this module participants are able to aquire	new sources of knowledge and apply their	knowledge to previou	ısly unknown issues a
	to present these.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S		npulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Bioprocess Engineering: Com	pulsory	
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		



Course L1107: Bioprocess Engineering - Advanced		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese, Dr. Wael Sabra	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture</li> <li>Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)</li> <li>Enzymatic process II (Prof. Liese)</li> <li>Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)</li> <li>Anaerobic fermentation processes (Prof. Zeng)</li> <li>Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)</li> <li>Fedbatch process and cultivation with high cell density (Prof. Zeng)</li> <li>Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)</li> <li>Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)</li> <li>Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)</li> </ul>	
Literature	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 Enginee	ring - Advanced
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture</li> <li>Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)</li> <li>Enzymatic process II (Prof. Liese)</li> <li>Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)</li> <li>Anaerobic fermentation processes (Prof. Zeng)</li> <li>Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)</li> <li>Fedbatch process and cultivation with high cell density (Prof. Zeng)</li> <li>Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)</li> <li>Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)</li> <li>Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)</li> <li>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.</li> </ul>
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



Module M0539: Process an	d Plant Engineering I			
Courses				
Title		Тур	Hrs/wk	CP
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)	Dest Cours Fire	Recitation Section (small)	1	2
Module Responsible	Prof. Georg Fieg			
Admission Requirements	none			
Recommended Previous	unit operation of thermal an dmechanical separation processes			
Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical process	es		
	specify linear component equations of complex chemical processes			
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	- formulation of mass and energy balance equations and estimation of	of product streams		
	- estimation of component streams of chemical plants using linear col	mponent balance models		
	- solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of production	costs		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following	General Engineering Science (German program): Specialisation Program	cess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Biop	process Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specia	alisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	alisation Energy and Enviromental Eng	ineering: Elective Co	ompulsory
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Biop			
	General Engineering Science (English program): Specialisation Proc	0 0 1 7		
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia			and the same
	General Engineering Science (English program, 7 semester): Specia	iisation Energy and Enviromental Engi	ineering: Elective Co	mpulsory
	Process Engineering: Core qualification: Compulsory			

Course L0095: Process and Plant Engineering I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression



Module Manual B. So	c. "General Engineering Science (English program)"	Technische Universität Hamburg-H
	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	
Literatur		
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679  H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74	
	Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157	
	E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997	
	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916	
	R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte,	
	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004	
	J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988	
	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19	
	G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306	
	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213	
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133	
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfur	t, 2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991	
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001	
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg	
	D. Hairston, Chemical Engineering, October 2001, S. 31-37	
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002	
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511	

5. Rieker, G. Siekmann, Oneming rech. 57 (1365)ivi. 6, 5. 5	

K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824

S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169

J. Mittelstraß, Chem. -Ing.-Tech. 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, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112

G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98

H.J. Lang, Chem. Eng. 54(10),117, 1947

H.J. Lang, Chem. Eng. 55(6), 112, 1948

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

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



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



Module M0670: Particle Ted	chnology and Solids Process Engineering				
Courses					
Title		Тур	Hrs/wk	CP	
Particle Technology I (L0434)		Lecture	2	3	
Particle Technology I (L0435)		Recitation Section (small)	1	1	
Particle Technology I (L0440)		Laboratory Course	2	2	
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous	keine				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results			
Professional Competence					
Knowledge	After successful completion of the module students are able to				
	name and explain processes and unit-operations of sol				
	characterize particles, particle distributions and to discu	ss their bulk properties			
Skills	Students are able to				
	a change and decign apparetures and processes for call	do proceeding according to the desired solid	a arapartica of the are	duat	
	choose and design apparatuses and processes for solid		s properties of the pro	duci	
	asses solids with respect to their behavior in solids proc	essing steps			
	<ul> <li>document their work scientifically.</li> </ul>				
Personal Competence					
Social Competence	The students are able to discuss scientific topics orally with oth	er students or scientific personal and to dev	elop solutions for tec	hnical-scientific issues	
	a group.				
Autonomy	Students are able to analyze and solve questions regarding so	lid particles independently.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 minutes				
Assignment for the Following	General Engineering Science (German program): Specialisation	n Process Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisation	n Bioprocess Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory				
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineering: Con	pulsory		
	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): Specialisation Bioprocess Engineering: Compulsory				
	General Engineering Science (English program): Specialisation	n Energy and Enviromental Engineering: Co	mpulsory		
	General Engineering Science (English program): Specialisation	n Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): S	Specialisation Process Engineering: Compul	sory		
	General Engineering Science (English program, 7 semester): S	Specialisation Bioprocess Engineering: Com	pulsory		
	General Engineering Science (English program, 7 semester): S	Specialisation Energy and Enviromental Eng	ineering: Compulsor	/	
	Process Engineering: Core qualification: Compulsory				



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



## **Specialization Electrical Engineering**

Module M0708: Electrical E	ngineering III: Circuit Theory and Transients				
Courses					
Title		Тур	Hrs/wk	CP	
Circuit Theory (L0566)		Lecture	3	4	
Circuit Theory (L0567)		Recitation Section (small)	2	2	
Module Responsible	Prof. Arne Jacob				
Admission Requirements	none				
Recommended Previous	Electrical Engineering I and II, Mathematics I and II				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following	ng learning results			
<b>Professional Competence</b>					
Knowledge	Students are able to explain the basic methods for calculating periodic signals. They know the methods for transient analysis frequency behaviour and the synthesis of passive two-terminal-	s of linear networks in time and in frequer			
Skills	The students are able to calculate currents and voltages in line able to calculate transients in electrical circuits in time and frequency behaviour of passive to the frequency behaviour of th	uency domain and are able to explain the re			
Personal Competence					
Social Competence	Students work on exercise tasks in small guided groups. They a	re encouraged to present and discuss their	results within the gro	up.	
Autonomy	The students are able to find out the required methods for solv lectures continuously by means of short-time tests. This allow knowledge to other courses like Electrical Engineering I and Ma	s them to control independently their educ			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale					
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Electrical Engineering; Compulsory			
Curricula	General Engineering Science (German program): Specialisatio		nics: Compulsory		
	General Engineering Science (German program, 7 semester): S			npulsory	
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory				
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program, 7 semester): S	pecialisation Electrical Engineering: Compu	ılsory		
	Computational Science and Engineering: Specialisation Engine	eering Sciences: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: El	ective 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
Language	DE
Cycle	WiSe
Content	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
Literature	- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)
	- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)
	- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)
	- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

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



		<u></u>		
Courses				
litle little		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I: Time-	independent Fields (L0180)	Lecture	3	5
Theoretical Electrical Engineering I: Time-	Independent Fields (L0181)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathen	natik II, Mathematik III		
Recommended Previous Knowledge	Basic principles of electrical engineering and advance	d mathematics		
Educational Objectives	After taking part successfully at identa have received the	o following learning regults		
Educational Objectives Professional Competence	After taking part successfully, students have reached the	ie ioliowing learning results		
Knowledge	Students can explain the fundamental formulas, relation principal behavior of electrostatic, magnetostatic, and complex electromagnetic fields by means of superpositing the properties of the superposition of the superpo	d current density fields with regard to respecti sition of solutions for simple fields. The students	ve sources. They can d	escribe the properties
Skills	Students can apply Maxwell's Equations in integral r Furthermore, they are capable of applying a variety of assess the principal effects of given time-independent characterization of electrostatic, magnetostatic, and el them for practical applications.	f methods that require solving Maxwell's Equation sources of fields and analyze these quantitative	ons for more general pro ely. They can deduce me	oblems. The students aningful quantities for
Personal Competence				
Social Competence	Students are able to work together on subject relate sessions).	d tasks in small groups. They are able to pres	sent their results effectiv	ely (e.g. during exer
Autonomy	Students are capable to gather necessary information reflect their knowledge by means of activities that according the exam. Based on respective feedback, students are their knowledge obtained in this lecture and the conter	impany the lecture, such as short oral quizzes do expected to adjust their individual learning pro-	uring the lectures and ex cess. They are able to dr	ercises that are relate
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following	General Engineering Science (German program): Spec	cialisation Electrical Engineering: Compulsory		
	General Engineering Science (German program, 7 sen	nester): Specialisation Electrical Engineering: Co	ompulsory	
Curricula				
Curricula	Electrical Engineering: Core qualification: Compulsory			
Curricula	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Spec			
Curricula		sialisation Electrical Engineering: Compulsory	mpulsory	



Course Lordo. Theoretical Liectifican	Engineering I: Time-Independent Fields
Тур	Lecture
Hrs/wk 3	3
CP 5	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
	Prof. Christian Schuster
0 0	DE .
	SoSe
Content -	- Maxwell's Equations in integral and differential notation
-	- Boundary conditions
-	- Laws of conservation for energy and charge
-	- Classification of electromagnetic field properties
-	- Integral characteristics of time-independent fields (R, L, C)
-	- Generic approaches to solving Poisson's Equation
-	- Electrostatic fields and specific methods of solving
-	- Magnetostatic fields and specific methods of solving
-	- Fields of electrical current density and specific methods of solving
-	- Action of force within time-independent fields
-	- Numerical methods for solving time-independent problems
Literature -	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
-	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
-	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
-	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
-	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
-	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Course L0181: Theoretical Electrica	Il Engineering I: Time-Independent Fields
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Schuster
. 33.	DE
	SoSe
Content	- Maxwell's Equations in integral and differential notation
	- Boundary conditions
	- Laws of conservation for energy and charge
	- Classification of electromagnetic field properties
	- Integral characteristics of time-independent fields (R, L, C)
	- Generic approaches to solving Poisson's Equation
	- Electrostatic fields and specific methods of solving
	- Magnetostatic fields and specific methods of solving
	- Fields of electrical current density and specific methods of solving
	- Action of force within time-independent fields
	- Numerical methods for solving time-independent problems
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)



Module M0748: Materials in	Electrical Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Electrotechnical Experiments (L0714)		Lecture	1	1
Materials in Electrical Engineering (L0685)		Lecture	2	3
Materials in Electrical Engineering (Problem	m 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	e following learning results		
Professional Competence				
Knowledge	Students can explain the composition and the structura	al properties of materials used in electrical engir	neering. Students can e	explicate the relevance o
	mechanical, electrical, thermal, dielectric, magnetic and	chemical properties of materials in view of their	applications in electrica	l engineering.
Skille	Students can identify appropriate descriptive models	and apply them mathematically. They can de	rive approximative colu	utions and judge factors
Okins	influential on the performance of materials in electrical e		iive approximative son	ations and judge lactors
Personal Competence Social Competence	Students can jointly solve subject related problems in course.	groups. They can present their results effective	ely within the framewor	k of the problem solvin
Autonomy	Students are capable to extract relevant information from	om the provided references and to relate this in	formation to the conten	t of the lecture. They car
	reflect their acquired level of expertise with the help of	of lecture accompanying measures such as exa	m typical exam questic	ons. Students are able to
	connect their knowledge with that acquired from other le	ectures.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following	General Engineering Science (German program): Spec	ialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 sem		mpulsory	
	Electrical Engineering: Core qualification: Compulsory		•	
	General Engineering Science (English program): Speci	alisation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 seme	· · · ·	npulsory	
	Computational Science and Engineering: Specialisation			



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
Cycle	SoSe
Content	Agenda:
	- Natural sources of electricity
	- Oscilloscope
	- Characterizing signals
	- 2 terminal circuit elements
	- 2-ports
	- Power
	- Matching
	- Inductive coupling
	- Resonance
	- Radio frequencies
	- Transistor circuits
	- Electrical measurement
	- Materials for the EE
	- Electrical fun
Literature	Tietze, Schenk: "Halbleiterschaltungstechnik", Springer



Course L0685: Materials in Electrica	al Engineering
Тур	
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator.  Analysis of vibrations in a one-dimensional lattice.
	Phononic bandgap
	Introduction to quantum mechanics
	Wave function, Schrödinger's equation, observables and measurements.
	Quantum mechanical harmonic oscillator and spectral decomposition.
	Symmetries, conserved quantities, and the labeling of states.
	Angular momentum
	The hydrogen atom
	Waves in periodic potentials
	Reciprocal lattice and reciprocal lattice vectors
	Band gap
	Band diagrams
	The free electron gas and the density of states
	Fermi-Dirac distribution
	Density of charge carriers in semiconductors  Conductivity in semiconductors. Engineering conductivity through doping.
	The P-N junction (diode)
	Light emitting diodes
	Electromagnetic waves interacting with materials
	Reflection and refraction
	Photonic band gaps
	Origins of magnetization
	Hysteresis in ferromagnetic materials
	Magnetic domains
Literature	Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials,
	Massachusetts Institute of Technology (MIT), 2013
	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
	12 Milipadia Milipadia
	13.Wikipedia, Wikimedia



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



ourses	
tle	Typ Hrs/wk CP
gnals and Systems (L0432)	Typ Hrs/wk CP  Lecture 3 4
gnals and Systems (L0433)	Recitation Section (large) 1 2
Module Responsible	Prof. Gerhard Bauch
Admission Requirements	None .
Recommended Previous	Mathematics 1-3
Knowledge	manoritation 1 o
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathematik 1-3 is exp Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are
	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic s
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which
	caused by the transition of a continuous-time signal to a discrete-time signal.
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can a
	the impact of LTI systems on the signal properties in time and frequency domain.
Personal Competence	
Social Competence	The students can jointly solve specific problems.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the I
·	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering (German program, 7 semester): Specialisation Mechanical Engineering (German program, 7 semester): Specialisation Mechanical Engineering (German program, 7 semester): Specialisation (German program, 7 semester): Specialisat
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engine
	Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



	ngineering IV: Transmission Lines ar			
Courses				
Title		Тур	Hrs/wk	СР
Research Seminar Electrical Engineering,	Computer Science, Mathematics (L0571)	Seminar	2	2
Transmission Line Theory (L0570)		Lecture	2	3
Transmission Line Theory (L0572)		Recitation Section (large)	2	1
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I-III, Mathematics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students can explain the fundamentals of wave p	ropagation on transmission lines at low and high free	quencies. They are ab	le to analyze circuits v
	transmission lines in time and frequency domain.	They can describe simple equivalent circuits of trans	smission lines. They a	re able to solve proble
	with coupled transmission lines. They can present	and discuss a self-chosen research topic.		
Skills	Students can analyze and calculate the propagati	ion of waves in simple circuits with transmission lines	s. They are able to ana	alvze circuits in freque
		alyze equivalent circuits of transmission lines. They	•	
	· ·	line equations. They are able to give a talk to profession	·	note including coup
	tanomicolon mico domg the vocama tanomicolon	mic equations. They are as to give a tank to proceed	oridio.	
Personal Competence				
Social Competence	Students can analyze and colve problems in small	all groups and discuss their solutions. They can comp	are the learned theer	with experiments in
30ciai Competence	·	le to present a research topic to professionals and disc		y with experiments in
	recture and discuss it in sman groups. They are abi	le to present a research topic to professionals and disc	Juss it with them.	
4.4	The state of the s	al and a late to a second	Photos Theory and	la da da al da da la lacacida d
Autonomy	· · ·	d are able to acquire skills from the lecture and the	•	
		el of knowledge by answering short questions and test		
	, , ,	cal Engineering I-III and Mathematics I-III). They can for	amiliarize themselves	with a research topic a
	can prepare a presentation.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	9.84		
Credit points	*			
Examination Examination duration and scale	Written exam			
	0 15 1 10 1 10			
Assignment for the Following	General Engineering Science (German program):		and the same	
Curricula		' semester): Specialisation Electrical Engineering: Con	npulsory	
	Electrical Engineering: Core qualification: Compuls	•		
	General Engineering Science (English program): S			
		semester): Specialisation Electrical Engineering: Com	npulsory	
	Computational Science and Engineering: Specialis			
	Technomathematics: Specialisation III. Engineering	• •		
	Technomathematics: Core qualification: Elective C	ompulsory		

Course L0571: Research Seminar Electrical Engineering, Computer Science, Mathematics	
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des SD E, Siavash Ahmadi Barogh
Language	DE/EN
Cycle	SoSe
Content	Seminar talk on a given subject
Literature	Themenabhängig / subject related



Course L0570: Transmission Line Theory		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle	SoSe	
Content	- Wave propagation along transmission lines - Transient behavior of transmission lines - Transmission lines in steady state - Impedance transformation and Smith chart - Equivalent circuits - Coupled transmission lines and symmetrical components	
Literature	- Unger, HG., "Elektromagnetische Wellen auf Leitungen", Hüthig Verlag (1991)	

Course L0572: Transmission Line Theory		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Arne Jacob	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0734: Electrical E	ngineering Project Laboratory			
Courses				
Title		Тур	Hrs/wk	CP
Electrical Engineering Project Laboratory (	1.0640)	Laboratory Course	5	6
Module Responsible	Prof. Christian Becker		<u> </u>	
Admission Requirements	None			
Recommended Previous	Electrical Engineering I, Electrical Engineering II			
Knowledge	3 11 3 , 11 11 3 11 3			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the techni			
	are capable of describing and communicating re		ate technical language. The	ey can explain the typical
	process of solving practical problems and present	related results.		
Skills	The students can transfer their fundamental known	owledge on electrical engineering to the proc	ess of solving practical pro	blems They identify and
o.i.no	overcome typical problems during the realization			
	conceptual solutions for non-standardized problem			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-su			
	engineering. They are able to effectively present a		•	•
	develop alternative approaches to an electrical en	gineering problem independently or in groups a	nd discuss advantages as we	ell as drawbacks.
Autonomy	Students are concluded independently coluing all	catrical angineering problems using provided li	toroturo. Thou are oble to fill	gana in as well as extent
Autonomy	Students are capable of independently solving el their knowledge using the literature and other so		•	
	pragmatically solve them by means of correspondi	· · · · ·	s, and dan mouningian, ox	iona givon probleme and
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Examination	Project			
Examination duration and scale	based on task + presentation			
Assignment for the Following	General Engineering Science (German program):	Specialisation Electrical Engineering: Compulso	ory	
Curricula	General Engineering Science (German program, 7		g: Compulsory	
	Electrical Engineering: Core qualification: Compul	•		
	General Engineering Science (English program): General Engineering Science (English program, 7		•	
	Technomathematics: Specialisation III. Engineerin		g. Compuisory	
	Technomathematics: Ore qualification: Elective C			

Course L0640: Electrical Engineering Project Laboratory			
Тур	Laboratory Course		
Hrs/wk	5		
CP	6		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Lecturer	Prof. Christian Becker, Dozenten des SD E		
Language	DE		
Cycle	SoSe		
Content	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained		
	systems, such as radar devices, networks of sensors, amateur radio transceiver, 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		
Literature	completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).		
	sompleton of the projects (testile notes, textileness, mandalo, and sheets, memor pages).		



Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential	Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential	Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041) Complex Functions (L1042)		Recitation Section (small)  Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz	Treoritation decition (large)		•
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge	made i iii			
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence	3,,	5 5		
Knowledge				
, and modge	Students can name the basic concepts in Mathematics	s IV. They are able to explain them using appre	opriate examples.	
	<ul> <li>Students can discuss logical connections between the</li> </ul>	ese concepts. They are capable of illustrating	these connections wi	th the help of example
	They know proof strategies and can reproduce them.			
Skills	Ot death and and delivered to Malk and the BA 186	the dealer of the comments of all all to the comme		and the stant to the
	Students can model problems in Mathematics IV with	the help of the concepts studied in this course	e. Moreover, they are	capable of solving th
	by applying established methods.	and the second s		
	Students are able to discover and verify further logical  Transition and black the state of	· ·		
	For a given problem, the students can develop and ex	ecute a suitable approach, and are able to crit	ically evaluate the re	SUITS.
Personal Competence				
Social Competence	Students are able to work together in teams. They are	canable to use mathematics as a common lar	iailaae	
	In doing so, they can communicate new concepts accommunicate new concepts accommunicate new concepts.			can decian evample
		cording to the needs of their cooperating part	ners. Moreover, trey	can design example
	check and deepen the understanding of their peers.			
Autonomy	Students are capable of checking their understanding	g of complex concepts on their own. They ca	n specify open quest	ions precisely and kr
	where to get help in solving them.	, ,	-1 7 -1	, ,
	Students have developed sufficient persistence to be a	able to work for longer periods in a goal-orien	ed manner on hard p	roblems.
			,	
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equations	2)		
Assignment for the Following	General Engineering Science (German program): Specialisat			
Curricula	General Engineering Science (German program): Specialisat		nics: Compulsory	
	General Engineering Science (German program): Specialisat			eerina: Compulsorv
	General Engineering Science (German program): Specialisat			3 ,,
	General Engineering Science (German program, 7 semester)	' '	ulsory	
	General Engineering Science (German program, 7 semester)		•	npulsory
	General Engineering Science (German program, 7 semest			
	Compulsory	ory. Openianouten meenamea. Engineering,	1 0000 111001000011	noonamoar Enginoor
	General Engineering Science (German program, 7 semester)	: Specialisation Naval Architecture: Compulso	rv	
	Computer Science: Specialisation Computational Mathematic	·	• •	
	Electrical Engineering: Core qualification: Compulsory	s. Liective Compulsory		
	General Engineering Science (English program): Specialisati	on Floatrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati		.: 0	
	General Engineering Science (English program): Specialisati			oring: Compulation
	General Engineering Science (English program): Specialisati		-	ening: Compulsory
	General Engineering Science (English program, 7 semester):			naulaan.
	General Engineering Science (English program, 7 semester):	,		
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engineering,	rocus Theoretical N	nechanical Engineer
	Compulsory			
	General Engineering Science (English program, 7 semester):	·	У	
	Computational Science and Engineering: Specialisation Engi	neering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisation Com	puter Science: Elective Compulsory		
	Computational Science and Engineering: Specialisation Com Mechanical Engineering: Specialisation Theoretical Mechanic	•		
	1	cal Engineering: Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mechanic	cal Engineering: Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mechanic Mechanical Engineering: Specialisation Mechatronics: Comp	cal Engineering: 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
	<ul> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

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

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

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



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

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



Module M0675: Introduction	n to Communications and Random Processes			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Communications and Rand	om Processes (L0442)	Lecture	3	4
Introduction to Communications and Rand	om Processes (L0443)	Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1-3     Signals and Systems     Basic knowledge of probability theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students know and understand the fundamental building bloc blocks using knowledge of signal and system theory as well a evaluation criteria of information transmission and are able to des	s the theory of stochastic processes.	The are aware of the	-
Skills	The students are able to design and evaluate a basic commu- bandwidth and power. They are able to assess essential evalual error rate and to decide for a suitable transmission method.			
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from approperiod by solving tutorial problems, software tools, clicker system.	•	ntrol their level of know	rledge during the lecture
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation I	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spi	ecialisation Electrical Engineering: Com	npulsory	
	Computer Science: Specialisation Computer and Software Engine	eering: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation E			
	General Engineering Science (English program, 7 semester): Spe		pulsory	
	Computational Science and Engineering: Specialisation Enginee Technomathematics: Specialisation III. Engineering Science: Elec			
	Technomathematics: Specialisation III. Engineering Science: Electromathematics: Core qualification: Elective Compulsory	aive Compuisory		
	100/momationatios. Oure qualification. Liective Compulsory			



Course L0442: Introduction to Comm	munications and Random Processes
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	WiSe
Content	Fundamentals of random processes
	Introduction to communications engineering
	Quadrature amplitude modulation
	Description of radio frequency transmission in the equivalent complex baseband
	Transmission channels, channel models
	Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)
	Fundamentals of information theory, source coding, channel coding
	Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
	Fundamentals of digital modulation
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner
	P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
	M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
	S. Haykin: Communication Systems. Wiley
	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Course L0443: Introduction to Communications and Random Processes	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Madula MOZOO Maaaaa	unto Mathada and Data Ducas sino			
Module MU783: Measureme	ents: Methods and Data Processing			
Courses				
Title		Тур	Hrs/wk	СР
EE Experimental Lab (L0781)		Laboratory Course	2	2
Measurements: Methods and Data Proces	ssing (L0779)	Lecture	2	3
Measurements: Methods and Data Proces	ssing (L0780)	Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	none			
Recommended Previous	principles of mathematics			
Knowledge	principles of electrical engineering			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	· · ·	etrology and the acquisition and processing of measu ochastic signals. Students know methods to digitalize a	•	
Skills	The students are able to evaluate problems of metr	ology and to apply methods for describing and proces	sing of measurements.	
Personal Competence				
Social Competence	The students solve problems in small groups.			
Autonomy	The students can reflect their knowledge and discu	ss and evaluate their results.		
Workload in Hours	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): 9	Specialisation Electrical Engineering: Compulsory		
Curricula		semester): Specialisation Electrical Engineering: Elec	tive Compulsory	
	Computer Science: Specialisation Computer and S			
	Electrical Engineering: Core qualification: Compuls			
	General Engineering Science (English program): S			
		semester): Specialisation Electrical Engineering: Elect	ive Compulsory	
	Computational Science and Engineering: Specialis		avo compaisory	
	Computational Science and Engineering: Specialis			
	Technomathematics: Specialisation III. Engineering	• • •		
	Technomathematics: Core qualification: Elective Co	ompulsory		

Course L0781: EE Experimental Lab	
Тур	Laboratory Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer, Prof. Christian Schuster, Prof. Günter Ackermann, Prof. Rolf-Rainer Grigat, Prof. Arne Jacob, Prof. Herbert Werner, Dozenten
	des SD E, Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines
Literature	Wird in der Lehrveranstaltung festgelegt

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



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



Module M0568: Theoretical	Electrical Engineering II: Time-Dependent	Fields		
Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering II: Time-	Dependent Fields (L0182)	Lecture	3	5
Theoretical Electrical Engineering II: Time-	Dependent Fields (L0183)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I, Electrical Engineering II, Theoreti	ical Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, Mathematic			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence	2, 2,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Knowledge				
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret then with regard to practical applications.			
Personal Competence Social Competence	Students are able to work together on subject related t sessions).	asks in small groups. They are able to pres	sent their results effectiv	ely (e.g. during exercise
Autonomy	Students are capable to gather necessary information frr reflect their knowledge by means of activities that accomp the exam. Based on respective feedback, students are exacquired knowledge and ongoing research at the Hambu	pany the lecture, such as short oral quizzes du expected to adjust their individual learning produced	uring the lectures and excess. They are able to dr	ercises that are related to
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following	General Engineering Science (German program): Special	lisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semes		ompulsory	
	Electrical Engineering: Core qualification: Compulsory		•	
	General Engineering Science (English program): Speciali	sation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semes	ter): Specialisation Electrical Engineering: Co	mpulsory	
	Technomathematics: Specialisation III. Engineering Scien	ce: Elective Compulsory		
	Technomathematics: Core qualification: Elective Compuls	sory		



Course L0182: Theoretical Electrical	al Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	DE
Cycle	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
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



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



Module M0760: Electronic	Devices				
Courses					
Title	-	Гур	Hrs/wk	CP	
Electronic Devices (L0720)		_ecture	3	4	
Electronic Devices (L0721)		Problem-based Learning	2	2	
Module Responsible	Prof. Hoc Khiem Trieu				
Admission Requirements	None				
Recommended Previous	Atomic model and quantum theory, electrical currents in solid state materials,	basics in solid-state physics			
Knowledge	Successful participation of Physics for Engineers and Materials in Electrical E	naineering or courses with eau	ivalent contents		
	Occossial participation of Thysics in Engineers and Materials in Electron E	ingineering or courses with equ	arvaient contents		
Educational Objectives	After taking part successfully, students have reached the following learning re	esults			
<b>Professional Competence</b>					
Knowledge					
	Students are able				
	As a second the basis of consistent destruction				
	<ul> <li>to represent the basics of semiconductor physics,</li> </ul>				
	to explain the operating principle of important semiconductor devices.				
	to outline device characteristics and equivalent circuits as well as to explain their derivation and				
	to discuss the limitation of device models.				
Skills					
SKIIIS					
	Students are capable				
	to apply devices in basic circuits,				
		16			
	to realize the physical context and to solve complex problems by ones.	SelT			
Personal Competence					
Social Competence		as well as to present and discu	ss the results in front	of audience.	
·					
Autonomy		epare their experiments.			
Workload in Hours					
Credit points					
Examination					
Examination duration and scale  Assignment for the Following		agineering: Compulsory			
Assignment for the Following Curricula			Isory		
Junicula	Electrical Engineering: Core qualification: Compulsory	2.558.568 Engineering. Compa	,		
	General Engineering Science (English program): Specialisation Electrical En	gineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation		sory		



Course L0720: Electronic Devices	
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	<ul> <li>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)</li> <li>pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode)</li> <li>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)</li> <li>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)</li> </ul>
Literature	S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011)
	T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004)
	B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)
	D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)
	M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996)
	S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007)
	H. Schaumburg: Halbleiter, B.G. Teubner (1991)
	A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992)
	HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

Course L0721: Electronic Devices	
Тур	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



Module M0777: Semicondu	ictor Circuit Design			
Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L0763)		Lecture	3	4
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2
Module Responsible	NN	Houldion oconon (small)		
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge				
· ·	Basics of physics			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge		· · · · · · · · · · · · · · · · · · ·		
	Students are able to explain the functionality or			
		cuits and can discuss their advantages and disad		
		circuits and can explain their functionality and spe	echications.	
	Students know the appropriate fields for the us	e or bipolar transistors.		
Skills				
Okins	Students can calculate the specifications of diff	ferent MOS devices and can define the parameter	s of electronic circuits.	
	Students are able to develop different logic circ	cuits and can design different types of logic circuits	S.	
	<ul> <li>Students can use MOS devices, operational ar</li> </ul>	mplifiers and bipolar transistors for specific applica	itions.	
Personal Competence				
Social Competence	Students are able work efficiently in heterogen	oous tooms		
	Students are able work eniciently in neterogen     Students working together in small groups can		ne	
	cadona noming agains in aman groupe can	corresponding and another protectional queens		
Autonomy				
,	Students are able to assess their level of know	ledge.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Mecha	atronics: Compulsory	
	General Engineering Science (German program, 7 se	mester): Specialisation Electrical Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical Engineering, I	Focus Mechatronics: Com	pulsory
	Electrical Engineering: Core qualification: Compulsory	1		
	General Engineering Science (English program): Spec	cialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Spec	cialisation Mechanical Engineering, Focus Mecha	tronics: Compulsory	
	General Engineering Science (English program, 7 ser	nester): Specialisation Electrical Engineering: Cor	mpulsory	
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical Engineering, F	ocus Mechatronics: Comp	oulsory
	Mechanical Engineering: Specialisation Mechatronics	: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Com	pulsory		
	Technomathematics: Specialisation III. Engineering So	cience: Elective Compulsory		



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





	s of Management			
urses				
9		Тур	Hrs/wk	CP
oduction to Management (L0880)		Lecture	3	3
ect Entrepreneurship (L0882)		Problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
-	None			
-	Basic Knowledge of Mathematics and Business			
Knowledge				
	After taking part successfully, students have reached the following	learning results		
Professional Competence	3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3		
Knowledge	After taking this module, students know the important basics of m	anv different areas in Business and Mar	nagement, from Plani	ning and Organisati
•	Marketing and Innovation, and also to Investment and Controlling.			9 9
	explain the differences between Economics and Managem	ent and the sub-disciplines in Managem	ent and to name impo	ortant definitions froi
	field of Management			
	explain the most important aspects of and goals in Manage			
	describe and explain basic business functions as product		cnain management,	organization and ni
	ressource management, information management, innovat		Itiala ahiaatiyaa aad	uncertainty and av
	<ul> <li>explain the relevance of planning and decision making in some basic methods from mathematical Finance</li> </ul>	business, esp. in situations under mu	niple objectives and	uncertainty, and ex
	state basics from accounting and costing and selected cont	rolling methods		
	state basies from accounting and costing and solicited com	rolling methods.		
Skills	Students are able to analyse business units with respect to	different criteria (organization, object	tives, strategies etc	.) and to carry ou
	Entrepreneurship project in a team. In particular, they are able to			
	analyse Management goals and structure them appropriate	lv.		
	analyse organisational and staff structures of companies	· y		
	apply methods for decision making under multiple objective	es, under uncertainty and under risk		
	analyse production and procurement systems and Busines			
	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 controlli	ng to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	<ul> <li>work successfully in a team of students</li> </ul>			
	to apply their knowledge from the lecture to an entrepreneu	rship 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			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation E	lectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation C	omputer Science: Compulsory		
	General Engineering Science (German program): Specialisation P	rocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation B	ioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation E	nergy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (German program): Specialisation C	ivil- and Enviromental Engeneering: Cor	npulsory	
	General Engineering Science (German program): Specialisation N	lechanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation B	iomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation N			
	General Engineering Science (German program, 7 semester): Spe		•	
	General Engineering Science (German program, 7 semester): Spe	cialisation Process Engineering: Compu	lsory	
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): Spe	·	-	
	General Engineering Science (German program, 7 semester): Spe	·	•	
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): Spe		•	
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Foc	us Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Foc	us Aircraft Systems E	ngineering: Compul
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering	, Focus Materials in	Engineering Scie
	General Engineering Science (German program, 7 semester): Compulsory	Specialisation Mechanical Engineering	, Focus Materials ir	Engineering Scie



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

 $General\ Engineering\ Science\ (English\ program):\ Specialisation\ Bioprocess\ Engineering:\ Compulsory$ 

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Compulsory\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Mechanical\ Engineering,\ M$ 

General Engineering Science (English program, 7 semester); Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

 $\label{thm:mechanical engineering:Core qualification:Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



	Lecture
Typ	3
Hrs/wk	
	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. Wolfga
Lannuara	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona  DE
Language	WiSe/SoSe
Cycle	WISE/SOSE
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales</li> <li>Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	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.

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



## **Specialization Computer Science**

Module M0561: Discrete Al	gebraic Structures			
Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures (L0164)		Lecture	2	3
Discrete Algebraic Structures (L0165)		Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None.			
Recommended Previous	Mathematics from High School.			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic s	structures including elementary combinate	orial structures, mono	ids, groups, rings, fields,
	finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Chille	Charleste are able to formalise and analyse basis discusts also be			
Skills	Students are able to formalize and analyze basic 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.		
Autonom	Charles are able to assume a surface and a form and all forms			
Autonomy	Students are able to acquire new knowledge from specific stands	ard books and to associate the aquired kni	owledge to other clas	ses.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisation		ony	
Surricula	Computer Science: Core qualification: Compulsory	occidinguisti Computer Colence. Compulsi	O.,	
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation		orv	
	Computational Science and Engineering: Core qualification: Cor	·	,	
	Technomathematics: Specialisation I. Mathematics: Elective Con			
	Toomonation about opening about it was formation. Elective Out			

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

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



Module M0553: Objectorien	ted Programming, Algorithms and D	Oata Structures		
Courses				
Title		Тур	Hrs/wk	СР
Objectoriented Programming, Algorithms a	and Data Structures (L0131)	Lecture	4	4
Objectoriented Programming, Algorithms a	and Data Structures (L0132)	Recitation Section (small)	1	2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended Previous	Lecture Prozedurale Programmierung or equivale	ent proficiency in imperative programming		
Knowledge	Manufatan managarinita fanthia laakuu ia anafaia	in interestina automatica (C. Bassal Fastura es si	miles Verenberdebe	familias suite aissala el
		ncy in imperative programming (C, Pascal, Fortran or si for, while, procedure calls or function calls, pointers, ar	*	·
		n editor, compiler, linker and debugger. In this lecture w	•	•
	objects and we will not repeat the basics mention		o will illimodiatory oto	
		, LUM because those prerequisites are <b>not</b> part of the cu		
	those curricula in general. The programs ET, CI a	nd IIW include those prerequisites in the first semester in	the lecture Prozedura	ale Programmierung.
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge		design and the design of a class architecture with re	eference to existing of	lass libraries and des
	patterns.			
	Students can describe fundamental data structure	es of discrete mathematics and assess the complexity of	important algorithms for	or sorting and searchin
Skills	Students are able to			
	Design software using given design natter	rns and applying class hierarchies and polymorphism		
		using version management systems and Google Test		
	Sort and search for data efficiently	tonig voicion management by blank and accegne root		
	Assess the complexity of algorithms.			
Personal Competence				
Social Competence	Students can work in teams and communicate in	forums.		
Autonomy	Students are able to solve programming tasks su	ch as LZW data compression using SVN Repository and	d Google Test indeper	ndently and over a per
	of two to three weeks.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minutes, Content of Lecture, exercises and ma	aterial in StudIP		
Assignment for the Following	General Engineering Science (German program)	: Specialisation Computer Science: Compulsory		
Curricula		7 semester): Specialisation Computer Science: Computer	sory	
	Computer Science: Core qualification: Compulsor	•		
	Electrical Engineering: Core qualification: Compu			
	General Engineering Science (English program):			
		7 semester): Specialisation Computer Science: Compuls	sory	
	Computational Science and Engineering: Core que Logistics and Mobility: Specialisation Engineering			
	Technomathematics: Core qualification: Compuls			
	recimonatifematics. Gore quantication. Computs	ou y		



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

Course L0132: Objectoriented Prog	ramming, 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



Module M0624: Logic, Auto	mata and Formal Languages			
Courses				
Title		Тур	Hrs/wk	CP
Logic, Automata Theory and Formal Lange	Ianes (I 0332)	Lecture	2	4
Logic, Automata Theory and Formal Langi		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 structures (such as, e.g., ar	rays) to solve computational problems		
	- apply propositional logic and predicate logic for specifying ar	nd understanding mathematical proofs		
	- apply the knowledge and skills taught in the module Discrete	Algebraic Structures		
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
	logic, and therefore, the students can motivate predicate logic Students can explain unification and resolution for solving the decision problems for various kinds of temporal logic, and idea automata and can identify relationships to logic and form nondeterministic finite automata and pushdown automata to expressive than determinism. They are also able to demonstransform decision problems w.r.t. one formalism into decision	respondences to Boolean algebra. Students can describe which application problems are hard to represent with propositional estudents can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Initication and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and arious kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite entity relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is more ninism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can polems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily induce ters are best suited for specifying systems and their properties. Students can describe the relationships between formalisms such rammars.		
Skills	Students can apply propositional logic as well as predicate logic derive propositional logic, predicate logic, or temporal logic fo application problem, and they can demonstrate the application nondeterministic automata into deterministic ones, or derive gapply algorithms for the language emptiness problem in case	rmulas to represent them. They can evaluate on of algorithms for decision problems to s grammars from automata and vice versa. Th	e which formalism is be specific formulas. Stud	est suited for a particula ents can also transform
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Computer Science: Elective 0	Compulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	n Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester):		Compulsory	
	Computational Science and Engineering: Core qualification: C			
	Technomathematics: Specialisation II. Informatics: Elective Co	mpulsory		



Course L0332: Logic, Automata The	ory and Formal Languages
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Tobias Knopp
Language	EN
Cycle	SoSe
Content	Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
	Predicate logic, unification, predicate logic resolution
	3. Temporal Logics (LTL, CTL)
	Deterministic finite automata, definition and construction
	Regular languages, closure properties, word problem, string matching
	6. Nondeterministic automata:
	Rabin-Scott transformation of nondeterministic into deterministic automata
	7. Epsilon automata, minimization of automata,
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
	8. Myhill-Nerode Theorem:
	Correctness of the minimization procedure, equivalence classes of strings induced by automata
	9. Pumping Lemma for regular languages:
	provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be 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	
	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: Logic, Automata The	Course L0507: Logic, 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	



tile gnals and Systems (L0432) gnals and Systems (L0433)	Typ Hrs/w	vk CP
gnals and Systems (L0432)	Typ nis/w	
	Lecture 3	4
	Recitation Section (large) 1	2
Module Responsible	Prof. Gerhard Bauch	
	None	
·	Mathematics 1-3	
Knowledge	Mathematics 1-5	
· ·	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the module Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not re	
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	nd system theory. They a
	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe a	nd analyse deterministic
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain	n and image domain wh
	caused by the transition of a continuous-time signal to a discrete-time signal.	
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of	f signal and system theor
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability	y, linearity etc They can
	the impact of LTI systems on the signal properties in time and frequency domain.	
Personal Competence		
Social Competence	The students can jointly solve specific problems.	
	The students are able to acquire relevant information from appropriate literature sources. They can control their level of	of knowledge during the
· ·	period by solving tutorial problems, software tools, clicker system.	
	Independent Study Time 124, Study Time in Lecture 56	
	6	
	Written exam	
	90 min	
-	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory	
	General Engineering Science (German program): Specialisation Computer Science: Compulsory	
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory	
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory	
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan	nics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Sys	stems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys	stems Engineering: Comp
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mate Compulsory	erials in Engineering Sc
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni	ice: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theor Compulsory	Cocai mechanicai Engin
	Computer Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering: Core quantication: Compulsory  General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory	
	General Engineering Science (English program): Specialisation Giving and Environmental Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Electrical Engineering. Compulsory	
	General Engineering Science (English program): Specialisation Computer Science: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program): Specialisation Process Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Flocess Engineering: Compulsory	
	General Engineering Science (English program, 7 semester). Specialisation Electrical Engineering. Compulsory  General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Computer Science. Compulsory	
	General Engineering Science (English program, 7 semester). Specialisation Process Engineering. Compulsory  General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
	General Engineering Science (English program, 7 semester). Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
		ics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mate	
	Compulsory	3 James 60
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic	cs: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theorem	
	Compulsory Computational Science and Engineering: Core qualification: Compulsory	



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



			<u></u>	
ourses				
tle		Тур	Hrs/wk	СР
roduction to Management (L0880)		Lecture	3	3
oject Entrepreneurship (L0882)		Problem-based Learning	2	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	g results		
Professional Competence		-		
Knowledge				
	explain the differences between Economics and Management and	d the sub-disciplines in Managem	nent and to name impo	ortant definitions from t
	field of Management			
	explain the most important aspects of and goals in Management a			
	describe and explain basic business functions as production, pr		chain management,	organization and hum
	ressource management, information management, innovation ma		المحمد مصريفه منام مراسندار	
	<ul> <li>explain the relevance of planning and decision making in Busir some basic methods from mathematical Finance</li> </ul>	iess, esp. in situations under mu	inipie objectives and	uncertainty, and expi
	state basics from accounting and costing and selected controlling	methode		
	state basies from accounting and costing and screened controlling	metrous.		
Skills	Students are able to analyse business units with respect to differ Entrepreneurship project in a team. In particular, they are able to	ent criteria (organization, objec	ctives, strategies etc	.) and to carry out
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives, und	er uncertainty and under risk		
	analyse production and procurement systems and Business inforr			
	analyse and apply basic methods of marketing	nation dystems		
	select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from mathematical finance to precipe to the select and apply basic methods from the select and the select	lefined problems		
	apply basic methods from accounting, costing and controlling to p			
	apply basic inclined from accounting, cooling and conficining to p	reactified 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 p	roject and write a coherent repor	t on the project	
	to communicate appropriately and			
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
riationomy	olddonio dio dolo lo			
	<ul> <li>work in a team and to organize the team themselves</li> </ul>			
	to write a report on their project.			
Workload in Hours				
Credit points				
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrica	l Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Comput	er Science: Compulsory		
	General Engineering Science (German program): Specialisation Process	Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bioproce	ess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy	and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program): Specialisation Civil- an	d Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Mechan	ical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biomedi	cal Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Naval A	rchitecture: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisa	tion Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Biomedical Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Naval Architecture: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): Specialisa	tion Civil Engineering: Compulso	ry	
	General Engineering Science (German program, 7 semester): Specialisa	tion Energy and Enviromental En	gineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specia		•	
	Compulsory		, . 5565 Midiolidis II	gog oolell(
		ication Machanical Facination	Focus Theoretics!	Mochanical E
	General Engineering Science (German program, 7 semester): Special	ısalıdı ivlechanıca Engineering	, rocus meoretical l	vieci iai iicai ⊑ngineerii



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

inpulsory

 $General\ Engineering\ Science\ (German\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Energy\ Systems:\ Compulsory$ 

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Compulsory\ Mechanical\ Engineering,\ Focus\ Mechatronics:\ Mechanical\ Engineering,\ M$ 

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

 $\label{thm:mechanical engineering:Core qualification:Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolf	
	(ersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Manager Marketing and Sales         Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	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.	

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



Module M0852: Graph Theo	ory and Optimization			
Courses				
Title Graph Theory and Optimization (L1046) Graph Theory and Optimization (L1047)		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Anusch Taraz	Heditation Section (Smail)	2	3
Admission Requirements	none			
Recommended Previous	none			
Knowledge	Discrete Algebraic Structures     Mathematics I			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence Knowledge	Students can name the basic concepts in Graph Theory a     Students can discuss logical connections between these     They know proof strategies and can reproduce them.			•
Skills	<ul> <li>Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence Social Competence	Students are able to work together in teams. They are cape in doing so, they can communicate new concepts according check and deepen the understanding of their peers.			can design examples to
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program, 7 semester): Sp	pecialisation Computer Science: Comput	sory	
	Computer Science: Core qualification: Compulsory	0		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		sory	
	Computational Science and Engineering: Core qualification: Cor Logistics and Mobility: Specialisation Engineering Science: Elect			
	Technomathematics: Specialisation I. Mathematics: Elective Com			



Course L1046: Graph Theory and Optimization		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Anusch Taraz	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Graphs, search algorithms for graphs, trees</li> <li>planar graphs</li> <li>shortest paths</li> <li>minimum spanning trees</li> <li>maximum flow and minimum cut</li> <li>theorems of Menger, König-Egervary, Hall</li> <li>NP-complete problems</li> <li>backtracking and heuristics</li> <li>linear programming</li> <li>duality</li> <li>integer linear programming</li> </ul>	
Literature	<ul> <li>M. Aigner: Diskrete Mathematik, Vieweg, 2004</li> <li>J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007</li> <li>A. Steger: Diskrete Strukturen (Band 1), Springer, 2001</li> <li>A. Taraz: Diskrete Mathematik, Birkhäuser, 2012</li> <li>V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009</li> <li>KH. Zimmermann: Diskrete Mathematik, BoD, 2006</li> </ul>	

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



Module M0793: Seminars C	computer Science and Mathematics			
Courses				
Title		Тур	Hrs/wk	СР
Seminar Computational Mathematics/Com	puter Science (L0797)	Seminar	2	2
Seminar Computational Engineering Scien	ce (L0796)	Seminar	2	2
Seminar Engineering Mathematics/Compu	ter Science (L1781)	Seminar	2	2
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Basic knowledge in Computer Science, Mathematics	s, and eventually Engineering Science.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a rudimentary field of Computer Science, Mathematics, or Engineering Science.			
Skills	The students are able to elaborate self-reliantly a rudimentary subfield of Computer Science, Mathematics, or Engineering Science.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Presentation			
Examination duration and scale	Pro Seminar erfolgt der Scheinerwerb durch Präsentation (Seminarvortrag 25 min und Diskussion 5 min)			
Assignment for the Following	General Engineering Science (German program): Specialisation Computer Science: Compulsory			
Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory			
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Sp	ecialisation Computer Science: Compulsory		
	General Engineering Science (English program, 7 se	emester): Specialisation Computer Science: Con	npulsory	
	Computational Science and Engineering: Core qual	ification: Compulsory		

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

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



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



Module M0834: Computern	etworks and Internet Security			
	<u> </u>			
Courses				
Title		Тур	Hrs/wk	CP
Computer Networks and Internet Security	(L1098)	Lecture	3	5
Computer Networks and Internet Security	(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 reach	ed the following learning results		
Professional Competence				
Knowledge				
	systems in further studies and job.			
0.11				
Skills	Students are able to analyse common internet pro	stocols and evaluate the use of them in different domain	IS.	
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of high amo	ount of professional knowledge and can independently	learn and understand i	t.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program):	Specialisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program,	7 semester): Specialisation Computer Science: Elective	Compulsory	
	Computer Science: Core qualification: Compulsor	у		
	Electrical Engineering: Core qualification: Elective	Compulsory		
	General Engineering Science (English program):	Specialisation Computer Science: Compulsory		
	General Engineering Science (English program, 7	semester): Specialisation Computer Science: Elective	Compulsory	
	Computational Science and Engineering: Core qu	alification: Compulsory		
	Technomathematics: Specialisation II. Informatics:	: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics:	: Elective Compulsory		

Course L1098: Computer Networks	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
Language	EN
Cycle	WiSe
Content	In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs.  In the second part of the lecture an introduction to Internet security is given.  This class comprises:  Application layer protocols (HTTP, FTP, DNS) Transport layer protocols (TCP, UDP) Network Layer (Internet Protocol, routing in the Internet) Data link layer with media access at the example of Ethernet Multimedia applications in the Internet Network management Internet security: IPSec Internet security: Firewalls
Literature	<ul> <li>Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley</li> <li>Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage</li> <li>W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition</li> </ul> Further literature is announced at the beginning of the lecture.



Course 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				
Fitle Fitle		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				
Knowledge	Mathematik I + II for Engineering Students (german o	english) <b>or</b> Analysis & Linear Algebra I + II for	Technomathematicia	ans
	<ul> <li>basic MATLAB knowledge</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge	Students are able to			
·····				
	name numerical methods for interpolation, integration	on, least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and
	explain their core ideas,			
	repeat convergence statements for the numerical me-			
	<ul> <li>explain aspects for the practical execution of numeric</li> </ul>	al methods with respect to computational and	storage complexitx.	
Skills	Students are able to			
	<ul> <li>implement, apply and compare numerical methods us</li> </ul>	sing MATLAR		
	justify the convergence behaviour of numerical method		aorithm	
	select and execute a suitable solution approach for a		gonum,	
		g		
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously composed teams	(i.e. teams from different study programs and	hackground knowle	idae) evolain theoretic
	foundations and support each other with practical asp			age), explain illeoreit
	loundations and support each other with practical as	rects regarding the implementation of algorith	113.	
Autonomy	Students are capable			
	• to access whether the augmenting theoretical and pro-	stical avecrains are better asleed individually	arin a taam	
	<ul> <li>to assess whether the supporting theoretical and practice</li> <li>to assess their individual progess and, if necessary, to</li> </ul>		or iii a teaiii,	
	to assess their individual progess and, ir necessary, t	ask questions and seek neip.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisa		anics: Compulsorv	
	General Engineering Science (German program): Specialisa	• •		nces: Compulsory
	General Engineering Science (German program): Specialisa		0 0	,
	General Engineering Science (German program, 7 semester		ory	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engineering	, Focus Materials ir	Engineering Science
	Compulsory			
	General Engineering Science (German program, 7 semester	): Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester	): Specialisation Mechanical Engineering, Foo	us Biomechanics: Co	mpulsory
	Bioprocess Engineering: Specialisation A - General Bioproce	ess Engineering: Elective Compulsory		
	Computer Science: Specialisation Computational Mathemati	cs: Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Compulso	ory		
	General Engineering Science (English program): Specialisa	ion Computer Science: Compulsory		
	General Engineering Science (English program): Specialisa	ion Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisa	ion Mechanical Engineering, Focus Biomecha	anics: Compulsory	
	General Engineering Science (English program): Specialisa	ion Mechanical Engineering, Focus Materials	in Engineering Scien	ces: Compulsory
	General Engineering Science (English program, 7 semester)	: Specialisation Computer Science: Compulso	ry	
	General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical Engineering	, Focus Materials ir	Engineering Science
	Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester)	: Specialisation Mechanical Engineering, Foci	us Biomechanics: Co	mpulsory
	Computational Science and Engineering: Care qualifications	0		
	Computational Science and Engineering: Core qualification:	Compulsory		



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

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



Module M0731: Functional	Programming			
Courses				
Title		Тур	Hrs/wk	СР
Functional Programming (L0624)		Lecture	2	2
Functional Programming (L0625)		Recitation Section (large)	2	2
Functional Programming (L0626)		Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous	Discrete mathematics at high-school level			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge Skills Personal Competence Social Competence	Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.  Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.			
Autonomy	communicate in English.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Computer Science: Elective	Compulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Computer Science: Elective	Compulsory	
	Computational Science and Engineering: Specialisation Compu	ter Science: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Elective Com	pulsory		

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



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

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



Courses           Title         Typ         Hrs/wk         CP           Computer Architecture (L0793)         Lecture         2         3           Computer Architecture (L0794)         Problem-based Learning         2         2	Module M0791: Computer A	Architecture			
Title Computer Architecture (L0793) Computer Architecture (L0794) Computer Architecture (L0794) Computer Architecture (L0794) Computer Architecture (L0794) Rectation Section (smalt) Problem-based Learning 2 2 2 Computer Architecture (L1984) Rectation Section (smalt) 1 1  Module Responsible Prof. Heliko Falk  Admission Requirements Recommended Previous Knowledge Reducational Objectives Knowledge Reducational Objectives Alter taking part successfully, students have reached the following learning results  Professional Computers Knowledge This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, thoundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the scaled pipelining and the methods used for the acceleration or instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution or machine instructions and for memory hierarchies.  Skills The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy 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 110, Study Time in Lecture 70  Credit points  Exa	module moror. Computer A	remediate			
Computer Architecture (L0793) Computer Architecture (L0794) Problem-based Learning 2 2 2 Computer Architecture (L1894) Rectation Section (small) 1 1 1  Module Responsible Prof. Heliko Falk Admission Requirements None  Recommended Previoles Knowledge  Educational Objectives Knowledge  For I taking part successfully, students have reached the following learning results  Professional Computer Knowledge  This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration or instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution or machine instructions and for memory hierarchies.  Skills The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer a	Courses				
Computer Architecture (L0744) Problem-based Learning 2 2 Computer Architecture (L1864) Prof. Heliko Falk  Module Responsible Recommended Previous Knowledge Recommended Previous Knowledge  Educational Objectives Recommended Previous Knowledge  For I taking part successfully, students have reached the following learning results  Professional Competence Knowledge This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours  Morkload in Hours  Written exam  Examination duration and scale  O minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Australia (Special Experi	Title		Тур	Hrs/wk	СР
Module Responsible Recuirements None Recommended Previous Module "Computer Engineering"  Knowledge Educational Objectives Knowledge  Educational Objectives Reviews Module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Morkload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination duration and scale  Autonomy  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Elective Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Computer Architecture (L0793)		Lecture	2	3
Module Responsible Admission Requirements Recommended Previous Knowledge  Educational Objectives Frofessional Competence Knowledge  This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The student examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Computer Architecture (L0794)		Problem-based Learning	2	2
Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning results  Professional Competence Knowledge This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  Skills The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence Social Competence	Computer Architecture (L1864)		Recitation Section (small)	1	1
Recommended Previous Knowledge Educational Objectives Professional Competence  Knowledge This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instruction used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instruction used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.   Personal Competence  Social Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to solve similar problems alone or in a gro	Module Responsible	Prof. Heiko Falk			
Educational Objectives Professional Competence Knowledge  This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of instruction execution execution execution of the superscalar execution of the superscalar execution of the superscalar execution of the superscalar execution of machine instruction execution executi	Admission Requirements	None			
Educational Objectives   Professional Competence    **Rnowledge**  **Rnowledge**  **This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  **Skills**  **The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  **Personal Competence**  **Scial Competence**  **Scial Competence**  **Scial Competence**  **Students are able to solve similar problems alone or in a group and to present the results accordingly.  **Students are able to solve similar problems alone or in a group and to present the results accordingly.  **Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  **Workload in Hours**  **Independent Study Time 110, Study Time in Lecture 70  **Credit points**  **Stamination duration and scale**  **Personal Competence**  **Assignment for the Following**  **General Engineering Science (German program): Specialisation Computer Science: Compulsory  **Computer Science: Specialisation Computer and Software Engineering: Elective Compul	Recommended Previous	Module "Computer Engineering"			
Professional Competence Knowledge This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence Social Competence Social Competence Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours Credit points Written exam  Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program): Specialisation Computer Science: Compulsory Computer Science: Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer Science: Elective Compulsory	Knowledge				
This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Social Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  Examination and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Educational Objectives	After taking part successfully, students have reached the following	learning results		
models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Curricula  General Engineering Science (German program) and Software Engineering: Elective Compulsory	Professional Competence				
micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to 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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Knowledge	This module presents advanced concepts from the discipline of	computer architecture. In the beginning,	, a broad overview ov	rer various programming
instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Scial Competence  Students are able to solve similar problems alone or in a group and to present the results accordingly.  Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  Ominutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory		models is given, both for general-purpose computers and for sp	pecial-purpose machines (e.g., signal p	rocessors). Next, fou	ndational aspects of the
machine instructions and for memory hierarchies.  Skills  The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to 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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory		micro-architecture of processors are covered. Here, the focus par	ticularly lies on the so-called pipelining	and the methods use	ed for the acceleration of
The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to 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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory		instruction execution used in this context. The students get to	know concepts for dynamic scheduling	, branch prediction, s	superscalar execution of
examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory		machine instructions and for memory hierarchies.			
examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Skills	The students are able to describe the organization of processors	They know the different architectural prin	ciples and programm	na models. The students
performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.  Personal Competence  Social Competence  Students are able to solve similar problems alone or in a group and to 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 110, Study Time in Lecture 70  Credit points  Examination  Written exam  Examination duration and scale  90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Computer Science: Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	S.u.ne		·		-
Personal Competence Social Competence Social Competence Students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination Written exam  Examination duration and scale Assignment for the Following Curricula Curricula General Engineering Science (German program): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory					
Personal Competence Social Competence Students are able to solve similar problems alone or in a group and to present the results accordingly.  Autonomy Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination Written exam  Examination duration and scale Assignment for the Following Curricula Curricula Curricula Curricula Curricula Curricula Curricula Curricula Curricula Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory					
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 110, Study Time in Lecture 70  Credit points  Examination Written exam  Examination duration and scale Assignment for the Following Curricula Curricul		dictinguist solvest includes in and data to or parameters.			
Autonomy Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points Examination Written exam  Examination duration and scale Assignment for the Following Curricula Curr	Personal Competence				
Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and scale 90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following General Engineering Science (German program): Specialisation Computer Science: Compulsory  Curricula General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Social Competence	Students are able to solve similar problems alone or in a group an	d to present the results accordingly.		
Credit points 6  Examination Written exam  Examination duration and scale 90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following Curricula Curricula General Engineering Science (German program): Specialisation Computer Science: Compulsory Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Autonomy	Students are able to acquire new knowledge from specific literature	e and to associate this knowledge with o	other classes.	
Examination Written exam  Examination duration and scale 90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following Curricula General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Examination duration and scale 90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"  Assignment for the Following General Engineering Science (German program): Specialisation Computer Science: Compulsory  Curricula General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory  Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Credit points	6			
Assignment for the Following Curricula General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Examination	Written exam			
Curricula General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Examination duration and scale	90 minutes, contents of course and 4 attestations from the PBL "Co	omputer architecture"		
Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory	Assignment for the Following	General Engineering Science (German program): Specialisation (	Computer Science: Compulsory		
	Curricula	General Engineering Science (German program, 7 semester): Spe	ecialisation Computer Science: Elective (	Compulsory	
General Engineering Science (English program): Specialisation Computer Science: Compulsory		Computer Science: Specialisation Computer and Software Engine	ering: Elective Compulsory		
		General Engineering Science (English program): Specialisation C	omputer Science: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory		General Engineering Science (English program, 7 semester): Spe	cialisation Computer Science: Elective C	Compulsory	
Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory		Computational Science and Engineering: Specialisation Compute	r Science: Elective Compulsory		

Course L0793: Computer Architecto	ure
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	<ul> <li>Introduction</li> <li>VHDL Basics</li> <li>Programming Models</li> <li>Realization of Elementary Data Types</li> <li>Dynamic Scheduling</li> <li>Branch Prediction</li> <li>Superscalar Machines</li> <li>Memory Hierarchies</li> <li>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.</li> </ul>
Literature	<ul> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> </ul>



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

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



Module M0971: Operating S	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		ata atau atau a		
Knowledge	Object-oriented programming, algorithms, and d	ata structures		
	Procedural programming	atawa anaka ana Maran Patawa ana ana Mara		
	Experience in using tools related to operating sy	stems such as editors, linkers, compilers		
	Experience in using C-libraries			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students explain the main abstractions process, virtual	memory, deadlock, lifelock, and file of operations	s systems, describe the	process states and thei
	transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their			
	architectures. The participants of the course write concu	rrent programs using threads, conditional variab	les and semaphores. S	Students can describe the
	variants of realizing a file system. Students explain at lea	ast three different scheduling algorithms.		
OL III.	Ot all all and a shall be used the BOOM Plant for the		The second state to	to do a the a ffection of a
Skills	Students are able to use the POSIX libraries for cond		ay. They are able to	judge the efficiency of a
	scheduling algorithm for a given scheduling task in a given	en environment.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Speci	alisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Computer Science: Elective	Compulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Speci-	alisation Computer Science: Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Computer Science: Elective	Compulsory	
	Computational Science and Engineering: Specialisation	Computer Science: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Elect	ve Compulsory		

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

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



Module M0727: Stochastics	S			
Courses				
Title		Тур	Hrs/wk	CP
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			
	- Propositional rogic			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge				
	dependence, independence assumptions) used in discrete and			
	describe characteristic notions such as expected values, varia			·
	explain algorithms for solving these problems (based on the c			•
	analyzed in terms of notions such as bias of an estimator, etc. S		•	
OL III.	solving decision and computation problem for stochastic process			
Skills	Students can apply algorithms for solving decision problems, application contexts, i.e., students can derive estimators and judg			good enough in various
	application contexts, i.e., students can derive estimators and judg	e whether they are applicable of reliab	ie.	
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their regular home w	ork) in heterogeneously composed tea	ms (i.e., teams from diffe	erent study programs and
	background knowledge) and to present their results appropriatel	y (e.g. during exercise class).		
Autonomy	- Students are capable of checking their understanding of comple	x concepts on their own. They can spe	cify open questions pre	cisely and know where to
,	get help in solving them.	, , , , , , , , , , , , , , , , , , , ,	, , , ,	•
	- Students can put their knowledge in relation to the contents of o	ther lectures.		
	- Students have developed sufficient persistence to be able to wo	rk for longer periods in a goal-oriented	manner on hard proble	ms.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Computer Science: Compu	Ilsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp	·	Isory	
	Computational Science and Engineering: Core qualification: Con	•		
	Logistics and Mobility: Specialisation Engineering Science: Elect	ve Compulsory		



Course L0777: Stochastics					
Тур	Lecture				
Hrs/wk	2				
CP	4				
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28				
Lecturer	Francisco Javier Hoecker-Escuti				
Language	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				
	Fractical representations for joint probabilities				
	Bayessche Netzwerke				
	Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen				
	ochastic 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				
I have to we					
Literature	1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008				
	2. Stochastik für Informatiker, Dümbgen, L., Springer 2003				
	3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010				
	4. Stochastik, Georgii, HO., deGruyter, 2009				
	5. Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001				
	6. 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. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



## **Specialization Mechanical Engineering**

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

Graduates have:

- 1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.
- 2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.
- 3) In-depth knowledge in Engineering applications, especially in the selected subject area of specialisation (product development and manufacturing, material science, aircrafts, energy Engineering, mechatronics, medical engineering, theoretical mechanical engineering). They have in particular the necessary methodological knowledge and its application to engineering problems, taking into account technical specifications and economic and social parameters.
- 4) The ability to work scientifically and to expand their specialized knowledge independently.

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

-	Тур	Hrs/wk	СР
			1
			2
			2
	Problem-based Learning	2	1
Prof. Dieter Krause			
None			
Fundamentals of Mechanical Engineering Design	n		
Mechanics			
Production Engineering			
After taking part successfully, students have reached the	following learning results		
After passing the module, students are able to:			
<ul> <li>explain design guidelines for machinery parts e.g</li> </ul>	g. considering load situation, materials and manu	facturing requirements,	
<ul> <li>describe basics of 3D CAD,</li> </ul>			
<ul> <li>explain basics methods of engineering designing</li> </ul>	g.		
After a consistent the second of a set of contact of the second of the s			
After passing the module, students are able to:			
<ul> <li>independently create sketches, technical drawing</li> </ul>	gs and documentations e.g. using 3D CAD,		
<ul> <li>design components based on design guidelines</li> </ul>	autonomously,		
dimension (calculate) used components.			
	seign tacks evetamtically and colution-oriented		
	saight lasks systamically and solution-offened,		
apply creativity techniques in teams.			
After passing the module, students are able to:			
dovolon and evaluate colutions in groups includi	ing making and documenting desicions		
	ing making and documenting decisions,		
<ul> <li>present and discuss solutions and technical draw</li> </ul>	vings within groups,		
<ul> <li>reflect the own results in the work groups of the c</li> </ul>	course.		
Students are able			
<ul> <li>to estimate their level of knowledge using activa</li> </ul>	ating methods within the lectures (e.g. with clickers	\$),	
<ul> <li>To solve engineering design tasks systematically</li> </ul>	y.		
Independent Study Time 40, Study Time in Lecture 140			
6			
Written exam			
180			
General Engineering Science (German program): Speci-	alisation Energy and Enviromental Engineering: 0	Compulsory	
General Engineering Science (German program): Speci-	alisation Mechanical Engineering: Compulsory		
General Engineering Science (German program): Speci-	alisation Biomedical Engineering: Compulsory		
		ompulsory	
	, · · · · · · · · · · · · · · · · · · ·	igineering: Compulsory	
	• •		
General Engineering Science (English program): Specia	alisation Energy and Enviromental Engineering: C	ompulsory	
General Engineering Science (English program): Specia	alisation Mechanical Engineering: Compulsory		
0	alisation Biomedical Engineering: Compulsory		
General Engineering Science (English program): Specia	, ,		
	ester): Specialisation Mechanical Engineering: Co	mpulsory	
General Engineering Science (English program, 7 seme			
General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engineering: Co	mpulsory	
General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engineering: Colester): Specialisation Energy and Enviromental En	mpulsory	
General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engineering: Colester): Specialisation Energy and Enviromental En	mpulsory	
	Ponce  Fundamentals of Mechanical Engineering Desig Mechanics Fundamentals of Materials Science Production Engineering  After taking part successfully, students have reached the state passing the module, students are able to: explain design guidelines for machinery parts edescribe basics of 3D CAD, explain basics methods of engineering designing design basics methods of engineering designing design components based on design guidelines dimension (calculate) used components, use methods to design and solve engineering designing apply creativity techniques in teams.  After passing the module, students are able to: develop and evaluate solutions in groups included moderate the use of scientific methods, present and discuss solutions and technical draw reflect the own results in the work groups of the component students are able to estimate their level of knowledge using active to solve engineering design tasks systematically Independent Study Time 40, Study Time in Lecture 140 former and Engineering Science (German program): Specific General Engineering Science (German program): Specific General Engineering Science (German program, 7 sem General Engineering Scienc	Lecture Practical Course Practical Course Practical Course Problem-based Learning  Prof. Dieter Krause  None  Fundamentals of Mechanical Engineering Design  Fundamentals of Materials Science  Fundamentals of Materials Science  Production Engineering  After taking part successfully, students have reached the following learning results  After passing the module, students are able to:  explain design guidelines for machinery parts e.g. considering load situation, materials and manute describe basics of 3D CAD,  explain basics methods of engineering designing.  After passing the module, students are able to:  independently create sketches, technical drawings and documentations e.g. using 3D CAD,  design components based on design guidelines autonomously,  dimension (calculate) used components,  use methods to design and solve engineering design tasks systamtically and solution-oriented,  apply creativity techniques in teams.  After passing the module, students are able to:  develop and evaluate solutions in groups including making and documenting decisions,  moderate the use of scientific methods,  present and discuss solutions and technical drawings within groups,  reflect the own results in the work groups of the course.  Students are able  to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers)  to solve engineering design tasks systematically.  Independent Study Time 40, Study Time in Lecture 140  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulso	Lecture 2 Practical Course 3 Practical Course 2 Practical Course 3 Practical Course 3 Practical Course 2 Problem-based Learning 2 Problem-based Le



Naval Architecture: Core qualification: Compulsory

Course L0268: Embodiment Design	and 3D-CAD			
Тур	Lecture			
Hrs/wk				
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	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>			

Course L0695: Mechanical Design F	Course L0695: Mechanical Design Project I				
Тур	Practical Course				
Hrs/wk	3				
CP	2				
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42				
Lecturer	Prof. Thorsten Schüppstuhl				
Language	DE				
Cycle	WiSe				
Content	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	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>				



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

Course L0267: Team Project Design	n Methodology		
Тур	Problem-based Learning		
Hrs/wk			
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	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Module M0933: Fundament	als of Materials Science					
nodale mosso. i dildaliletti	als of materials objetice					
Courses						
itle		Тур	Hrs/wk	CP		
Fundamentals of Materials Science I (L1085)		Lecture	2	2		
	anced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2		
hysical and Chemical Basics of Materials		Lecture	2	2		
Module Responsible	*					
Admission Requirements	None					
Recommended Previous	Highschool-level physics, chemistry und mathematics					
Knowledge						
Educational Objectives	After taking part successfully, students have reached the following	learning results				
Professional Competence		·				
Knowledge	The students have acquired a fundamental knowledge on m	etals, ceramics and polymers a	nd can describe this know	rledge comprehensive		
•	Fundamental knowledge here means specifically the issues of a					
	mechanical properties. The students know about the key aspec	cts of characterization methods for	materials and can identify	relevant approaches		
	characterizing specific properties. They are able to trace materials	s phenomena back to the underlyin	g physical and chemical lav	vs of nature.		
Chillo	The students are able to trace meterials phanemans head to the	underlying physical and shemical	lowe of nature Materials a	hanamana hara rafarr		
Skills	The students are able to trace materials phenomena back to the					
	mechanical properties such as strength, ductility, and stiffness, c					
	solidification, precipitation, or melting. The students can explain		onditions and the materials	microstructure, and t		
	can account for the impact of microstructure on the material's beh	avioi.				
Paysanal Campatana						
Personal Competence						
Social Competence	-					
Autonomy	Indiana de A Chidu Timo OC Chidu Timo in Lankius OA					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Examination	Written exam					
Examination duration and scale	180 min					
Assignment for the Following	General Engineering Science (German program): Specialisation					
Curricula	General Engineering Science (German program): Specialisation					
	General Engineering Science (German program): Specialisation		ory			
	General Engineering Science (German program): Specialisation					
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory						
i	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory					
	Canada Fasinassias Caisass (Communication 7	anialization Naval Assistants	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory			
	General Engineering Science (German program, 7 semester): Sp	ecialisation Energy and Enviromen		у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com	ecialisation Energy and Enviromen oulsory	ntal Engineering: Compulsor	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program): Specialisation (	ecialisation Energy and Enviromen oulsory Energy and Enviromental Engineeri	ntal Engineering: Compulsor	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I	ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso	ntal Engineering: Compulsor ing: Compulsory ory	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I	ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso Biomedical Engineering: Compulso	ntal Engineering: Compulsor ing: Compulsory ory	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I	ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso Biomedical Engineering: Compulso Naval Architecture: Compulsory	ntal Engineering: Compulsor ing: Compulsory ory rry	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso Biomedical Engineering: Compulso Naval Architecture: Compulsory ecialisation Mechanical Engineerin	ntal Engineering: Compulsor ing: Compulsory ory ry g: Compulsory	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Spe General Engineering Science (English program, 7 semester): Spe General Engineering Science (English program, 7 semester): Spe	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso Biomedical Engineering: Compulso Javal Architecture: Compulsory ecialisation Mechanical Engineering ecialisation Biomedical Engineering	ntal Engineering: Compulsor ing: Compulsory ory g: Compulsory g: Compulsory	у		
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineeri Mechanical Engineering: Compulso Biomedical Engineering: Compulso Javal Architecture: Compulsory ecialisation Mechanical Engineering ecialisation Naval Architecture: Compulsion	atal Engineering: Compulsor  ing: Compulsory  pry  g: Compulsory g: Compulsory mpulsory mpulsory			
	General Engineering Science (German program, 7 semester): Special Engineering Science (Harding Science) (Harding Science	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineering Compulsory Biomedical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedical Engineering Engineering Edilisation Mechanical Engineering  Biomedical Eng	atal Engineering: Compulsor  ing: Compulsory  pry  g: Compulsory g: Compulsory mpulsory mpulsory			
	General Engineering Science (German program, 7 semester): Special Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science: Elect	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineering Compulsory Biomedical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedical Engineering Engineering Edilisation Mechanical Engineering  Biomedical Eng	atal Engineering: Compulsor  ing: Compulsory  pry  g: Compulsory g: Compulsory mpulsory mpulsory			
	General Engineering Science (German program, 7 semester): Special Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I Special Engineering Science (English program, 7 semester): Special Engineering Science (English program, 7 semester): Special Engineering Science (English program, 7 semester): Specialisation Engineering Science: Elect Mechanical Engineering: Core qualification: Compulsory	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineering Compulsory Biomedical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedical Engineering Engineering Edilisation Mechanical Engineering  Biomedical Eng	atal Engineering: Compulsor  ing: Compulsory  pry  g: Compulsory g: Compulsory mpulsory mpulsory			
	General Engineering Science (German program, 7 semester): Special Engineering Science (English program): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation I General Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science: Elect	ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineering Compulsory Biomedical Engineering: Compulsory Biomedical Engineering: Compulsory Biomedical Engineering Engineering Edilisation Mechanical Engineering  Biomedical Eng	atal Engineering: Compulsor  ing: Compulsory  pry  g: Compulsory g: Compulsory mpulsory mpulsory			

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



Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)				
Тур	ecture			
Hrs/wk	2			
СР	2			
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Lecturer	rof. Bodo Fiedler, Prof. Gerold Schneider			
Language	)E			
Cycle	SoSe			
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau un			
	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 Chemic	cal 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



Module M0610: Electrical N	lachines				
Courses					
Title Electrical Machines (L0293) Electrical Machines (L0294)		Typ Lecture	Hrs/wk 3 2	<b>CP</b> 4 2	
	But Of the Advance	Recitation Section (large)	2	2	
Module Responsible	Prof. Günter Ackermann				
Admission Requirements	none	-P-1-			
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals, different	entials			
Knowledge	Basics of electrical engineering and mechanical engineering				
Educational Objectives	After taking part successfully, students have reached the following learn	ing results			
Professional Competence					
Knowledge	Students can to draw and explain the basic principles of electric and ma	ignetic fields.			
	They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.				
Skills	Students arw able to calculate two-dimensional electric and magnetic fi methods of the design auf electric machines.				
	They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.				
Personal Competence Social Competence Autonomy	none				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 Minuten				
Assignment for the Following	General Engineering Science (German program): Specialisation Energy	and Enviromental Engineering: Co	mpulsorv		
Curricula	General Engineering Science (German program): Specialisation Mecha				
	General Engineering Science (German program, 7 semester): Specialis	ation Energy and Enviromental Eng	ineering: Compulsory	/	
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering: Elec	tive Compulsory		
	Electrical Engineering: Core qualification: Elective Compulsory				
	Energy and Environmental Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Energy	and Enviromental Engineering: Cor	mpulsory		
	General Engineering Science (English program): Specialisation Mecha	nical Engineering: Elective Compuls	sory		
	General Engineering Science (English program, 7 semester): Specialisa	ation Energy and Enviromental Engi	neering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisa	tion Mechanical Engineering: Elect	ive Compulsory		
	Computational Science and Engineering: Specialisation Engineering Science	ciences: Elective Compulsory			
	Logistics and Mobility: Specialisation Engineering Science: Elective Co.	mpulsory			
	Mechanical Engineering: Core qualification: Elective Compulsory				
Mechatronics: Core qualification: Compulsory					



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

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



Module M0865: Fundamen	tals of Production and Quality N	<b>M</b> anagement		
Courses				
Γitle		Тур	Hrs/wk	СР
Production Process Organization (L0925)		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 hav	re reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the contents of the lecture of the module.			
Skills	Students are able to apply the methods and models in the module to industrial problems.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following	General Engineering Science (German pro	ogram): Specialisation Mechanical Engineering: Elective Co	ompulsory	
Curricula	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanical Engineering	: Elective Compulsory	
	General Engineering Science (English pro	ogram): Specialisation Mechanical Engineering: Elective Co	mpulsory	
	General Engineering Science (English pro	ogram, 7 semester): Specialisation Mechanical Engineering	: Elective Compulsory	
	Logistics and Mobility: Specialisation Engi	neering Science: Elective Compulsory		
	Mechanical Engineering: Core qualificatio	n: Elective Compulsory		

Course L0925: Production Process	Organization
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
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 Management	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
Content	Definition and Relevance of Quality     Continuous Quality Improvement     Quality Management in Product Development     Quality Management in Production Processes     Design of Experiments
Literature	<ul> <li>Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002</li> <li>Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001</li> <li>Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008</li> <li>Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009</li> </ul>



Courses				
			H	
itle ignals and Systems (L0432)		Тур	Hrs/wk 3	<b>CP</b> 4
ignals and Systems (L0432)		Lecture Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	ricolation coolion (large)		
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			-
Knowledge	Mathematics 1-3			
Kilowicage	The modul is an introduction to the theory of signals and systems. $\ensuremath{^{\circ}}$	Good knowledge in maths as covere	d by the moduls Math	nematik 1-3 is exper
	Further experience with spectral transformations (Fourier series, Four	rier transform, Laplace transform) is us	seful but not required.	
Educational Objectives	After taking part successfully, students have reached the following lev	arning reculte		
	After taking part successfully, students have reached the following lea	arning results		
Professional Competence	The students are able to already and describe simple and linear time	a investigat (LTI) avatages value mostle		and the same. The same
Knowledge	The students are able to classify and describe signals and linear time to apply the fundamental transformations of continuous-time and disc			
	and systems mathematically in both time and image domain. In pa			
	caused by the transition of a continuous-time signal to a discrete-time		ii liille dollialii alid ii	nage domain which
Skilla		•	na mathada af aignal	and avotam theory
Skills	The students are able to describe and analyse deterministic signals can analyse and design basic systems regarding important propertie	•	-	
			Jonse, stability, lineari	ny etc They can as
Paraonal Compatance	the impact of LTI systems on the signal properties in time and frequen	icy domain.		
Personal Competence	The students are initially as the second for a subdeman			
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from appropri	ate literature sources. They can contr	rol their level of know	ledge during the lea
	period by solving tutorial problems, software tools, clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Elec	ctrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Con	nputer Science: Compulsory		
	General Engineering Science (German program): Specialisation Prod	cess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biop	process Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Civi	I- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Med	chanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bior	medical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specia	alisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester): Specia	alisation Computer Science: Compulso	ory	
	General Engineering Science (German program, 7 semester): Specia	alisation Process Engineering: Compu	ilsory	
	General Engineering Science (German program, 7 semester): Specia	alisation Bioprocess Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester): Specia	alisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering, Foc	us Biomechanics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering, Foc	us Energy Systems: C	Compulsory
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering, Foc	us Aircraft Systems Er	ngineering: Compuls
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering, Foc	us Mechatronics: Con	npulsory
	General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engineering,	, Focus Theoretical M	Mechanical Enginee
	Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil	- and Enviromental Engeneering: Cor	npulsory	
	General Engineering Science (English program): Specialisation Biop	rocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Elec	trical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Com	puter Science: Compulsory		
	General Engineering Science (English program): Specialisation Med	hanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Biom	nedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Proc	ess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specia	lisation Electrical Engineering: Compu	ulsory	
	General Engineering Science (English program, 7 semester): Specia	lisation Computer Science: Compulso	ry	
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia	lisation Bioprocess Engineering: Com	ipulsory	
	General Engineering Science (English program, 7 semester): Specia	lisation Biomedical Engineering: Com	ipulsory	
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foci	us Biomechanics: Con	npulsory
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foci	us Energy Systems: Cr	ompulsory
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foci	us Aircraft Systems En	gineering: Compuls
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering	, Focus Materials in	Engineering Scien
Compulsory				
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foci	us Mechatronics: Com	ipulsory
	General Engineering Science (English program, 7 semester): Spe	ecialisation Mechanical Engineering,	Focus Theoretical M	Mechanical Enginee
	Compulsory			
	Computational Science and Engineering: Core qualification: Compul-	sory		



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



Module M0680: Fluid Dynai	mics			
•				
Courses				
Title		Тур	Hrs/wk	CP
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	none			
Recommended Previous	Sound knowledge of engineering mathematics, engineering med	hanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the			
	outline the rationale of flow physics using mathematical models	and are familiar with methods for the p	erformance analysis a	and the prediciton of flui
	engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow	physics models for the analysis of techni	ical systems. The lectu	re enables the student t
	carry out all necessary theoretical calculations for the fluid dynar	ic design of engineering devices on a so	cientific level.	
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop so	lution strategies.		
Autonomy	The students are able to develop solution strategies for complex	problems self-consistent and crtically and	alyse results.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		mpulaaru	
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp	ů ů	. ,	
	General Engineering Science (German program): Specialisation	•	501 y	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		mpulsorv	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			
	Computational Science and Engineering: Specialisation Engine		-	
	Mechanical Engineering: Core qualification: Compulsory	•		
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

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



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



Module M0934: Advanced	Materials			
module moso4. Advanced	materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterization (L10	187)	Lecture	2	2
Advanced Materials Design (L1091)		Lecture	2	2
Advanced Materials Design (L1092)		Recitation Section (large)	2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	none			
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materia	als along with their applications in t	echnology, in par	ticular metallic, ceramic,
	polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Chille	The students will be able to releat material souf-constitute according to	Abo toological accordance if accord		
Skills	The students will be able to select material configurations according to			
	architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to			
	select optimum materials combinations depending on the technical applic	alions.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to develop ideas further.			
Autonomy	The students are able to			
	assess their own strengths and weaknesses.			
	define tasks independently.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Mechani	cal Engineering: Elective Compulsor	У	
Curricula	General Engineering Science (German program, 7 semester): Specialisati	on Mechanical Engineering: Elective	e Compulsory	
	General Engineering Science (English program): Specialisation Mechanic	cal Engineering: Elective Compulsor	У	
	General Engineering Science (English program, 7 semester): Specialisation	on Mechanical Engineering: Elective	Compulsory	
	Mechanical Engineering: Core qualification: Elective Compulsory			

Course L1087: Advanced Materials	Course L1087: Advanced Materials Characterization		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Patrick Huber		
Language	DE		
Cycle	SoSe		
Content	1. Porous Solids - Preparation, Characterization and Functionalities		
	2. Fluidics with nanoporous membranes		
	3. X-ray diffraction for microstructure analysis		
	4. Thermoplastic elastomers		
	5. Optimization of polymer properties by nanoparticles		
	6. Fiber composites in automotive		
	7. Modeling of materials based on quantum mechanics		
	8. Mechanical properties of biomaterials		
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).		
	William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).		



Course L1091: Advanced Materials	Design
Тур	Lecture
Hrs/wk	2
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	Aluminiumlegierungen im Flugzeugbau:
	Korrosionsbeständige Varianten, Legierungen mit niedriger Dichte und hoher Steifigkeit; Ermüdungseigenschaften unter einsatznahen
	Belastungsbedingungen
	Titanlegierungen im Flugzeugbau:
	Hochtemperaturlegierungen für Flugtriebwerke (Kompressor):
	Optimierung von Kriech- und Schwingfestigkeit;
	höchstfeste Legierungen für Flugzeugstrukturbauteile:
	Optimierung von Streckgrenze und Bruchzähigkeit
	Demonstrationsversuche an Aluminium- und Titanlegierungen im Labor
	Metall-Keramik-Verbundwerkstoffe:
	spezifische Vor- und Nachteile
	Herstellung von Funktionskeramiken:
	Multilayer-Keramik für Aktoren in der Mikropositionierungstechnik am Beispiel der PZT-Keramik
	mechanische und elektrische Zuverlässigkeit von Funktionskeramiken
	neue Entwicklungen bei den Polymerlegierungen:
	z.B. thermoplastische Elastomere
	Polymer/Polymer-Verbundwerkstoffe:
	z.B. PE-Faser verstärktes PE
	biologisch abbaubare Polymere und polymere Verbundwerkstoffe:
	z.B. Flachsfasern in Polycaprolakton
	Aufbau und Eigenschaften intermetallischer Aluminide (auf Basis Fe, Ni, Ti)
	Herstellung und Anwendungen von intermetallischen Legierungen
	Phasen- und Gefügeanalyse eines Verbundwerkstoffes auf Basis intermetallischer Phasen (mit Laborübung)
Literature	Vorlesungsunterlagen

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



Module M0960: Mechanics	IV (Kinetics II, Oscillations, Analytical Mecha	nics. Multibody Systems)			
module mosoc. meenames	TV (Killedos II, Osoliiadolis, Alialydoal Illeolia	mos, manuscay oystems,			
Courses					
itle		Тур	Hrs/wk	CP	
lechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3	
	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2	
	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	none				
Recommended Previous	Mathematics I-III and Mechanics I-III				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence					
Knowledge	The students can				
	describe the axiomatic procedure used in mechanica	contexts:			
	<ul> <li>explain important steps in model design;</li> </ul>	,			
	<ul> <li>present technical knowledge.</li> </ul>				
Skills	The students can				
	explain the important elements of mathematical / med	hanical analysis and model formation, and app	olv it to the context of	their own problems:	
	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;</li> <li>apply basic methods to engineering problems;</li> </ul>				
	<ul> <li>estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.</li> </ul>				
Personal Competence					
Social Competence	The students can work in groups and support each other to o	vercome difficulties.			
Autonomy	Students are capable of determining their own strengths and	weaknesses and to organize their time and lea	arning based on thos	e.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Mechanical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisa				
04.1104.4	General Engineering Science (German program): Specialisa				
	General Engineering Science (German program, 7 semester		npulsorv		
	General Engineering Science (German program, 7 semester				
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering. Compulsory				
	General Engineering Science (English program): Specialisat				
	General Engineering Science (English program): Specialisat				
	General Engineering Science (English program): Specialisat	ion Naval Architecture: Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Mechanical Engineering: Com	pulsory		
	General Engineering Science (English program, 7 semester)				
	General Engineering Science (English program, 7 semester)	: Specialisation Naval Architecture: Compulsor	y		
	Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Science	Elective Compulsory			
	Technomathematics: Core qualification: Elective Compulsory	,			
	Theoretical Mechanical Engineering: Technical Complement	ary Course Core Studies: Elective Compulsory	1		

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	- Simple impact problems
	- Principles of analytical mechanics
	- Elements of vibration theory
	- Basics of continuum vibrations
	- Introduction into Modeling of Multibody Systems
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).



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

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



	ent Technology for Mechanical and Process En				
Courses					
Title		Тур	Hrs/wk	СР	
Practical Course: Measurement and Control Systems (L1119)		Laboratory Course	2	2	
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3	
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1	
Module Responsible	Dr. Sven Krause				
Admission Requirements	none				
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering	ng			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following	ng learning results			
Professional Competence					
Knowledge	Students are able to name the most important fundmentals of	the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static a	
	Dynamic Properties of Sensors and Systems).				
	They can outline the most important measuring methods for dif	forant kinds of quantities to be massured	(Floatrical Quantities	Fomporaturo mochani	
	quantities, Flow, Time, Frequency).	leterit killus of quantities to be maesured	(Liectical Quantities,	remperature, mechani	
	quantities, flow, fille, frequency).				
	They can describe important methods of chemical Analysis (Ga	s Sensors, Spectroscopy, Gas Chromatog	raphy)		
Skills	Students can select suitable measuring methods to given proble	ems and can use refering measurement de	evices in practice.		
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues in				
	the right context and application area.				
Personal Competence					
Social Competence	Students can arrive at work results in groups and document the	m in a common report.			
Autonomy	Students are able to familiarize themselves with new measuren	nent technologies.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	105 minutes				
Assignment for the Following	General Engineering Science (German program): Specialisatio		Compulsory		
Curricula	General Engineering Science (German program): Specialisatio				
	General Engineering Science (German program): Specialisatio				
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): S				
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory				
	Energy and Environmental Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (English program): Specialisation Riomedical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program): Specialisation Process Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): S	•		,	
	General Engineering Science (English program, 7 semester): S				
	General Engineering Science (English program, 7 semester): S				
	Mechanical Engineering: Core qualification: Compulsory	pos.aoation i roocos Engineening. Comp	u,		
	Mechatronics: Core qualification: Compulsory				
	Process Engineering: Core qualification: Compulsory				



Тур	Laboratory Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Wolfgang Schröder
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants
	automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigate
	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 Mich
	interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	Little We Dis Assistant des L. Grand Through and the control of the Alexandra and Alexandra C. A. G. Million and
	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenscha</li> </ul>
	<ul> <li>Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Mür</li> </ul>
	Wien, 1979
	<ul> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> </ul>
	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:
	Landard Fiefikana is die Dandurastaskeit Visuas Vedes Desusaskunis Wisskades
	Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden      Lap Lunzo: Systemtheoretische Grundlagen, Analyse und Enhaut einschleifiger Begelungen.
	<ul> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



Course L1116: Measurement Techn	Course L1116: Measurement Technology for Mechanical and Process Engineers		
	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Sven Krause		
Language	DE WiSe		
Content	1 Fundamentals		
	1.1 Quantities and Units		
	1.2 Uncertainty		
	1.3 Calibration		
	1.4 Static and Dynamic Properties of Sensors and Systems		
	2 Measurement of Electrical Quantities		
	2.1 Current and Voltage		
	2.2 Impedance		
	2.3 Amplification		
	2.4 Oscilloscope		
	2.5 Analog-to-Digital Conversion		
	2.6 Data Transmission		
	3 Measurement of Nonelectric Quantities		
	3.1 Temperature		
	3.2 Length, Displacement, Angle		
	3.3 Strain, Force, Pressure		
	3.4 Flow		
	3.5 Time, Frequency		
	4 Chemical Analysis		
	4.1 Gas Sensors		
	4.2 Spectroscopy		
	4.3 Gas Chromatography		
	At the end of each lecture students present single measuring techniques and results orally in front of the class.		
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 and Process Engineers	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Sven Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



odule M0829: Foundation	ns of Management			
ourses	Typ		Hrs/wk	CP
roduction to Management (L0880)	Typ Lectur	re.	3	3
oject Entrepreneurship (L0882)		em-based Learning	2	3
Module Responsible	Prof. Christoph Ihl	-		
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	Sasto Michiga of Mathematica and Sastings			
Educational Objectives	After taking part successfully, students have reached the following learning results	<b>.</b>		
Professional Competence	The along particles contains, cauche hard reached are relieving realising reaching	<u> </u>		
Knowledge	After taking this module, students know the important basics of many different are	eas in Business and Mar	nagement from Plant	ning and Organisation
ruiomoago	Marketing and Innovation, and also to Investment and Controlling. In particular the		agomon, nom man	mig and organication
		,		
	explain the differences between Economics and Management and the sub	o-disciplines in Managem	ent and to name impo	rtant definitions from
	field of Management			
	explain the most important aspects of and goals in Management and name			
	describe and explain basic business functions as production, procureme		chain management, o	organization and hum
	ressource management, information management, innovation managemen	-	Wale although a said	
	explain the relevance of planning and decision making in Business, especial methods from methods finance.	o. In situations under mu	tiple objectives and	uncertainty, and expi
	some basic methods from mathematical Finance     state basics from accounting and costing and selected controlling methods			
	state basics from accounting and costing and selected controlling methods			
Skills	Students are able to analyse business units with respect to different crite	ria (organization, objec	tives, strategies etc.	) and to carry out
	Entrepreneurship project in a team. In particular, they are able to			
	analyse Management goals and structure them appropriately			
	analyse management goals and studies them appropriately     analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives, under uncert	tainty and under risk		
	analyse production and procurement systems and Business information sy			
	analyse and apply basic methods of marketing	oloo		
	select and apply basic methods from mathematical finance to predefined p	roblems		
	apply basic methods from accounting, costing and controlling to predefined			
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 an	nd 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			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engine	ering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Computer Science	ce: Compulsory		
	General Engineering Science (German program): Specialisation Process Engineer	ering: Compulsory		
	General Engineering Science (German program): Specialisation Bioprocess Engin	neering: Compulsory		
	General Engineering Science (German program): Specialisation Energy and Envir	romental Engineering: Co	ompulsory	
	General Engineering Science (German program): Specialisation Civil- and Environ		npulsory	
	General Engineering Science (German program): Specialisation Mechanical Engi			
	General Engineering Science (German program): Specialisation Biomedical Engin			
	General Engineering Science (German program): Specialisation Naval Architectur			
	General Engineering Science (German program, 7 semester): Specialisation Elect			
	General Engineering Science (German program, 7 semester): Specialisation Proc			
	General Engineering Science (German program, 7 semester): Specialisation Biom			
	General Engineering Science (German program, 7 semester): Specialisation Nava		-	
	General Engineering Science (German program, 7 semester): Specialisation Com		•	
	General Engineering Science (German program, 7 semester): Specialisation Biop			
	General Engineering Science (German program, 7 semester): Specialisation Civil			
	General Engineering Science (German program, 7 semester): Specialisation Ener			
	General Engineering Science (German program, 7 semester): Specialisation Mecl			
	General Engineering Science (German program, 7 semester): Specialisation Mecl			
	General Engineering Science (German program, 7 semester): Specialisation Mecl		•	
	General Engineering Science (German program, 7 semester): Specialisation	Mechanical Engineering	, Focus Materials in	Engineering Science
	Compulsory		_	
	General Engineering Science (German program, 7 semester): Specialisation M	Mechanical Engineering,	Focus Theoretical N	Mechanical Engineeri



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

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

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compuis

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

 $General\ Engineering\ Science\ (English\ program):\ Specialisation\ Bioprocess\ Engineering:\ Compulsory$ 

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

 $General\ Engineering\ Science\ (English\ program):\ Specialisation\ Mechanical\ Engineering:\ Compulsory$ 

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Electrical\ Engineering:\ Compulsory$ 

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Process\ Engineering:\ Compulsory$ 

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Biomedical\ Engineering:\ Compulsory$ 

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester); Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

 $Logistics\ and\ Mobility: Core\ qualification: Compulsory$ 

 $\label{thm:mechanical engineering: Core qualification: Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Mana	gement	
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolf	
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales</li> <li>Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	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.	

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



## **Focus Biomechanics**

The specialization Biomechanics in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Biomechanics an economical oriented master study.

Module M1277: MED I: Intro	duction to Anatomy	
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 common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases.	
Personal Competence		
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.	
Autonomy	The students are able to passes anatomical knowledge by themselves can participate competently in conversations on the topic and esquire the	
Autonomy	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves.	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Examination	Written exam	
Examination duration and scale	90 minutes	
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory	
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory  Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
	Tosmonianomiasos. Oponianoason in Engineering Osienoe. Elective Outripuladry	



Course L0384: Introduction to Anatomy	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange
Language	
Cycle	
Content	General Anatomy
	1 <sup>st</sup> week: The Eucaryote Cell
	2 <sup>nd</sup> week: The Tissues
	3 <sup>rd</sup> week: Cell Cycle, Basics in Development
	4 <sup>th</sup> week: Musculoskeletal System
	5 <sup>th</sup> week: Cardiovascular System
	6 <sup>th</sup> week: Respiratory System
	7 <sup>th</sup> week: Genito-urinary System
	8 <sup>th</sup> week: Immune system
	9 <sup>th</sup> week: Digestive System I
	10 <sup>th</sup> week: Digestive System II
	11 <sup>th</sup> week: Endocrine System
	12 <sup>th</sup> week: Nervous System
	13 <sup>th</sup> week: Exam
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012



Courses	
<b>Title</b> ntroduction to Radiology and Radiation Th	Typ         Hrs/wk         CP           herapy (L0383)         Lecture         2         3
Module Responsible	Prof. Ulrich Carl
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives Professional Competence	After taking part successfully, students have reached the following learning results
Knowledge	
	Therapy
	The students can distinguish different types of currently used equipment with respect to its use in radiation therapy.
	The students can explain complex treatment plans used in radiation therapy in interdisciplinary contexts (e.g. surgery, internal medicine).
	The students can describe the patients' passage from their initial admittance through to follow-up care.
	Diagnostics
	The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as sectio imaging techniques (CT, MRT, US).
	The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques.
	The students can choose the right treatment method depending on the patient's clinical history and needs.
	The chulent can explain the influence of technical errors on the imaging techniques
	The student can explain the influence of technical errors on the imaging techniques.
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.
Skills	Therapy
	The students can distinguish curative and palliative situations and motivate why they came to that conclusion.
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.
	The students can use the therapeutic principle (effects vs adverse effects)
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose energy needed in that situation (irradiation planning).
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups social services, psycho-oncology).
	Diagnostics
	The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology a
	pathophysiology.
Personal Competence	
Social Competence	The students can assess the special social situation of tumor patients and interact with them in a professional way.
	The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet the
	appropriately.
Autonomy	
	The students can apply their new knowledge and skills to a concrete therapy case.
	The students can introduce younger students to the clinical daily routine.
	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire
	relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
Ourricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Engus Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory



Mechanical Engineering: Specialisation Biomechanics: Compulsory

Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory

Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory

Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory

Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0383: Introduction to Radio	ology and Radiation Therapy
Тур	Lecture
Hrs/wk	2
CP	
Workload in Hours Lecturer	Independent Study Time 62, Study Time in Lecture 28  Prof. Ulrich Carl, Prof. Thomas Vestring
Language	DE
Cycle	SoSe
Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments
Literature	"Technik der medizinischen Radiologie" von T. + J. Laubenberg –
	7. Auflage – Deutscher Ärzteverlag – erschienen 1999
	"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
	4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
	ISBN: 978-3-437-23960-1
	"Strahlentherapie und Onkologie für MTA-R" von R. Sauer –
	5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschienen 08.12.2009
	ISBN: 978-3-437-47501-6
	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	"Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000



Module M0662: Numerical N	Mathematics I			
Courses				
Title		Тур	Hrs/wk	CP
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
·	None			
Recommended Previous				
Knowledge	Mathematik I + II for Engineering Students (german or engine basic MATLAB knowledge	glish) <b>or</b> Analysis & Linear Algebra I + II fo	r Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
•	Students are able to			
	<ul> <li>name numerical methods for interpolation, integration, explain their core ideas,</li> <li>repeat convergence statements for the numerical method</li> <li>explain aspects for the practical execution of numerical method</li> </ul>	s,		finding problems and to
Skills	Students are able to			
	<ul> <li>implement, apply and compare numerical methods using</li> </ul>			
	<ul> <li>justify the convergence behaviour of numerical methods</li> </ul>	with respect to the problem and solution al	gorithm,	
	<ul> <li>select and execute a suitable solution approach for a give</li> </ul>	en problem.		
Personal Competence				
· ·	Students are able to			
ociai competence	Students are able to			
	<ul> <li>work together in heterogeneously composed teams (i.e. foundations and support each other with practical aspects</li> </ul>			edge), explain theoretica
Autonomy	Students are capable			
		I avecaniese and beauty actional individually.		
	to assess whether the supporting theoretical and practical		or in a team,	
	<ul> <li>to assess their individual progess and, if necessary, to as</li> </ul>	k questions and seek help.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
	90 minutes			
	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Assignment for the Following  Curricula	General Engineering Science (German program): Specialisation		anice: Compulsory	
Carriodia	General Engineering Science (German program): Specialisation			nces: Compulsory
	General Engineering Science (German program): Specialisation		, Engineering color	noon compansory
	General Engineering Science (German program, 7 semester): Sp		orv	
	General Engineering Science (German program, 7 semester)	·	•	n Engineering Sciences
	Compulsory		,,	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Biomedical Engineering: Cor	mpulsorv	
	General Engineering Science (German program, 7 semester): Sp			ompulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess			, ,
	Computer Science: Specialisation Computational Mathematics: I	Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program): Specialisation	Biomedical Engineering: Compulsory		
	deficial Engineering colonic (English program). Openation			
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Biomecha	anics: Compulsory	
		•		nces: Compulsory
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Materials	in Engineering Scier	nces: Compulsory
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester)	Mechanical Engineering, Focus Materials ecialisation Computer Science: Compulso	in Engineering Scier	
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester) Compulsory	Mechanical Engineering, Focus Materials ecialisation Computer Science: Compulso : Specialisation Mechanical Engineering	in Engineering Scier ory g, Focus Materials in	
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester) Compulsory General Engineering Science (English program, 7 semester): Sp	Mechanical Engineering, Focus Materials ecialisation Computer Science: Compulso: Specialisation Mechanical Engineering ecialisation Biomedical Engineering: Com	in Engineering Scier ory g, Focus Materials in npulsory	n Engineering Sciences
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester) Compulsory	Mechanical Engineering, Focus Materials ecialisation Computer Science: Compulso: Specialisation Mechanical Engineering ecialisation Biomedical Engineering: Comecialisation Mechanical Engineering, Focus	in Engineering Scier ory g, Focus Materials in npulsory	n Engineering Sciences



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

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



Madula MOCOA: Usat Turnat				
Module M0684: Heat Transf	er			
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following leaves	earning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an approximation $\boldsymbol{\varphi}$	proach.		
Autonomy	The students are able to develop a complex problem self-consisten	t and analyse the results in a critical wa	v. A qualified exchan	ge with other students is
	given.		.,	9
	<u> </u>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Biomecha	anics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Energy S	ystems: Compulsory	
	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering,	Focus Theoretical N	lechanical Engineering:
	Compulsory	islication Dispusation Francisco Con-		
	General Engineering Science (German program, 7 semester): Spec General Engineering Science (English program): Specialisation Bio		ipui501 y	
	General Engineering Science (English program): Specialisation Me		nics: Compulsory	
	General Engineering Science (English program): Specialisation Me	•		
	General Engineering Science (English program): Specialisation Me			ering: Compulsory
	General Engineering Science (English program, 7 semester): Specialistics (English program, 7 semester): Special		-	
	General Engineering Science (English program, 7 semester): Sp	-		
	Compulsory	3 /9,		<i>3g</i> .
	General Engineering Science (English program, 7 semester): Speci	alisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulse			
	Mechanical Engineering: Specialisation Theoretical Mechanical En	gineering: 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, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z. Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



Module M1279: MED II: Intro	oduction to Biochemistry and Molec	cular Biology		
Courses				
Title		Тур	Hrs/wk	CP
ntroduction to Biochemistry and Molecula	r Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	The students can			
	describe basic biomolecules;			
	explain how genetic information is coded			
	explain the connection between DNA and	d proteins;		
Skills	The students can			
	recognize the importance of molecular page.			
	describe selected molecular-diagnostic p			
	explain the relevance of these procedure	s for some diseases		
Personal Competence				
Social Competence	The students can participate in discussions in re-	search and medicine on a technical level.		
Autonomy	The students can develop understanding of topic	cs from the course, using technical literature, by themse	lves.	
Workload in Hours	Independent Study Time 62, Study Time in Lectu	ire 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following		): Specialisation Mechanical Engineering, Focus Biome	echanics: Compulsory	
Curricula		): Specialisation Biomedical Engineering: Compulsory	scriatiles. Compulsory	
Odificula		, 7 semester): Specialisation Biomedical Engineering: 0	Compulsory	
		, 7 semester): Specialisation Mechanical Engineering, 1		mnuleony
	Electrical Engineering: Specialisation Medical To		ocus biomechanics. Co	inpuisory
	* * '	: Specialisation Mechanical Engineering, Focus Biome	chanics: Compulsory	
			chanics. Compulsory	
		: Specialisation Biomedical Engineering: Compulsory	D'	
		7 semester): Specialisation Mechanical Engineering, F		npuisory
		7 semester): Specialisation Biomedical Engineering: C	ompulsory	
	Mechanical Engineering: Specialisation Biomed	· · ·		
		ment and Business Administration: Elective Compulsor	•	
		Organs and Regenerative Medicine: Elective Compuls	ory	
	* * '	Technology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants	' '		
	Technomathematics: Core qualification: Elective			
	Technomathematics: Specialisation III. Engineer	ing Science: Elective Compulsory		

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



Module M1333: BIO I: Impla	ints and Fracture Healing
Courses	
Title	Typ Hrs/wk CP
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	
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence.
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.
Skille	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.
OKIIIS	The students can determine the forces acting within the number body under quasi-static students under specific assumptions.
Personal Competence	
Social 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.
Autonomy	The state his carr, 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
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0376: Implants and Fractur	re Healing
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock DE
Language	
	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
	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



Module M1280: MED II: Intro	oduction to Physiology
Courses	
	To the state of th
Title Introduction to Physiology (L0385)	Typ         Hrs/wk         CP           Lecture         2         3
Module Responsible	Dr. Roger Zimmermann
Admission Requirements	None
Recommended Previous	None
Knowledge	
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can
	describe the basics of the energy metabolism;
	<ul> <li>describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology.</li> </ul>
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vi
	functions) and relate them to similar technical systems.
Personal Competence	
Social Competence	The students can conduct discussions in research and medicine on a technical level.  The students can find solutions to problems in the field of physiology, both analytical and metrological.
	The statems can find solutions to problems in the field of physiology, both analytical and filethological.
Autonomy	The students can derive answers to questions arising in the course and other physiological areas, using technical literature, by themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory  Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory  Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Technomathematics: Core qualification: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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



urses					
tle		Тур	Hrs/wk	CP	
operimental Methods in Biomechanics (L	0377)	Lecture	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous	It is recommended to participate in "Implantate un	nd Frakturheilung" before attending "Experimentelle	e Methoden".		
Knowledge					
Educational Objectives	After taking part successfully, students have read	hed the following learning results			
Professional Competence					
Knowledge	The students can describe the different ways how	v bones heal, and the requirements for their existen	ce.		
	The students can name different treatments for the	e spine and hollow bones under given fracture mor	rphologies.		
	The students can describe different measurement techniques for forces and movements, and choose the adequate technique for a given task.				
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.				
Personal Competence					
Social Competence	The students can, in groups, solve basic experim	nental tasks.			
•					
Autonomy	The students can, in groups, solve basic experim	ental tasks.			
Workload in Hours	Independent Study Time 62, Study Time in Lectu	re 28			
Credit points	3				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following	General Engineering Science (German program	): Specialisation Mechanical Engineering, Focus Bio	omechanics: Compulsory		
Curricula	General Engineering Science (German program	): Specialisation Biomedical Engineering: Compulsi	ory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program)	: Specialisation Mechanical Engineering, Focus Bio	mechanics: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	Mechanical Engineering: Specialisation Biomechanics: Compulsory				
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory				
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory				
	* * '	Technology and Control Theory: Elective Compulso	•		
	Biomedical Engineering: Specialisation Manage	ment and Business Administration: Elective Compu	lsory		
	Technomathematics: Specialisation III. Engineer	ing Colongo: Floative Compulatory			

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



## **Focus Energy Systems**

The specialization energy engineering in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Energy Engineering or an economical oriented master study.

	Mechanical Engineering Design				
Courses					
Title		Тур	Hrs/wk	СР	
dvanced Mechanical Engineering Design	ı II (L0264)	Lecture	2	2	
Advanced Mechanical Engineering Design	ı II (L0265)	Recitation Section (large)	2	1	
Advanced Mechanical Engineering Design		Lecture	2	2	
dvanced Mechanical Engineering Design		Recitation Section (large)	2	1	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous	Fundamentals of Mechanical Engineering Design				
Knowledge	Mechanics				
	Fundamentals of Materials Science				
	Production Engineering				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results			
Professional Competence					
Knowledge	After passing the module, students are able to:				
		him alamanta and of basis alamanta of flui	: 4:		
	explain complex working principles and functions of mac				
	explain requirements, selection criteria, application scen     indicate the background of dimensioning selections.	ands and practical examples of complex in	acrime elements,		
	<ul> <li>indicate the background of dimensioning calculations.</li> </ul>				
Skills	After passing the module, students are able to:				
	accomplish dimensioning calculations of covered machin     transfer knowledge learned in the module to new require				
	recognize the content of technical drawings and schema     avaluate complex designs, technically.	iic skeiches,			
	evaluate complex designs, technically.				
Personal Competence					
Social Competence					
	Students are able to discuss technical information in the	lecture supported by activating methods.			
Autonomy					
,	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings</li> </ul>				
	lectures.				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120				
Assignment for the Following	General Engineering Science (German program): Specialisation	Mochanical Engineering Focus Energy S	vetome: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			Compulsory	
Curricula	General Engineering Science (German program): Specialisation	• •			
	General Engineering Science (German program): Specialisation			ices. Compulsory	
	General Engineering Science (German program): Specialisation			duction: Compulsory	
	General Engineering Science (German program): Specialisation	• •			
	General Engineering Science (German program). Specialisation	• •	-		
	General Engineering Science (German program, 7 semester).				
	Compulsory	). Opeciansation Mechanical Engineering	g, rocus materiais ii	Linginieering ocien	
		necialisation Mechanical Engineering Foo	us Mechatronics: Cor	mnulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production				
	Compulsory				
		: Specialisation Mechanical Engineering	Focus Theoretical I	Mechanical Enginee	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory				
		pecialisation Mechanical Engineering Foo	us Biomechanics: Co	mnulsorv	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory				
				Compulsory	
	General Engineering Science (English program): Specialisation				
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Materials	in Engineering Scien	ices, Compuisorv	
	General Engineering Science (English program): Specialisation		-	ices. Compulsory	
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Mechatro	nics: Compulsory	, ,	
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Mechatron Mechanical Engineering, Focus Product D	nics: Compulsory evelopment and Prod	duction: Compulsory	
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Mechatro Mechanical Engineering, Focus Product D Mechanical Engineering, Focus Theoretic	nics: Compulsory evelopment and Prod al Mechanical Engine	duction: Compulsory eering: Compulsory	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Specialisation	Mechanical Engineering, Focus Mechatro Mechanical Engineering, Focus Product D Mechanical Engineering, Focus Theoretic Decialisation Mechanical Engineering, Focus	nics: Compulsory levelopment and Prod al Mechanical Engine us Aircraft Systems En	duction: Compulsory pering: Compulsory ngineering: Compuls	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Specialises General Engineering Science (English program, 7 semester)	Mechanical Engineering, Focus Mechatro Mechanical Engineering, Focus Product D Mechanical Engineering, Focus Theoretic Decialisation Mechanical Engineering, Focus	nics: Compulsory levelopment and Prod al Mechanical Engine us Aircraft Systems En	duction: Compulsory pering: Compulsory ngineering: Compuls	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Specialise Engineering Science (English program, 7 semester): Compulsory	Mechanical Engineering, Focus Mechatro Mechanical Engineering, Focus Product D Mechanical Engineering, Focus Theoretic Decialisation Mechanical Engineering, Focus Decialisation Mechanical Engineering	nics: Compulsory levelopment and Prod al Mechanical Engine us Aircraft Systems En I, Focus Materials in	duction: Compulsory pering: Compulsory ngineering: Compuls n Engineering Scien	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Specialises General Engineering Science (English program, 7 semester)	Mechanical Engineering, Focus Mechatro Mechanical Engineering, Focus Product D Mechanical Engineering, Focus Theoretic Decialisation Mechanical Engineering, Focus Decialisation Mechanical Engineering, Focus Decialisation Mechanical Engineering, Focus	nics: Compulsory levelopment and Proc al Mechanical Engine us Aircraft Systems En I, Focus Materials in us Mechatronics: Con	duction: Compulsory pering: Compulsory ngineering: Compuls n Engineering Scien	



Compulsory

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

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

Naval Architecture: Core qualification: Compulsory

Course L0264: Advanced Mechanic	al 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
Comon	
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	• Elements or indices
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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



Course L0262: Advanced Mechanic	al Engineering Design I	
	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	Advanced Mechanical Engineering Design I & II	
Comon		
	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 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	District Control of Control Manager Control Mill Follows (Control Manager Control Manager Cont	
	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.      Auf der Auftrag der Auf	
	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



Module M0655: Computation	onal Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	CP
Computational Fluid Dynamics I (L0235)		Lecture	2	3
Computational Fluid Dynamics I (L0419)		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Mathematical Methods for Engineers			
Knowledge	Fundamentals of Differential/integral calculus and series	expansions		
	-	·		
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial differen	tial equations.		
ļ				
ļ				
Skills	The students are able develop appropriate numerical integrati	on in space and time for the governing	partial differential ed	quations. They can code
ļ.	computational algorithms in a structured way.			
ļ				
Personal Competence				
Social Competence	The students can arrive at work results in groups and document i	hem		
ļ				
Autonomy	The students can independently analyse approaches to solving	specific problems.		
,		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
Assignment for the Following	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Energy	Systems: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architecture: Compuls	ory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering, Fo	cus Energy Systems:	Elective Compulsory
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Energy S	systems: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	·	•	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foo	us Energy Systems: E	Elective Compulsory
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele			
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

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



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



Module M0639: Gas and Sto	eam Power Plants			
Courses				
Title		Тур	Hrs/wk	СР
Gas and Steam Power Plants (L0206)		Lecture	3	4
Gas and Steam Power Plants (L0210)		Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous				
Knowledge	"Technical Thermodynamics I and II"      "Illust Tours for"			
	"Heat Transfer"     "Fluid Mechanics"			
	Truid Westrames			
<b>Educational Objectives</b>	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	The students can evaluate the development of the electric	ity demand and the energy conversion routes i	n the thermal power p	lant, describe the vario
	types of power plant and the layout of the steam general	ator block. They are also able to determine th	e operation character	istics of the power pla
	Additionally they can describe the exhaust gas cleaning	• •	of conventional fossil-	uelled power plants v
	solar thermal and geothermal power plants or plants equip	pped with Carbon Capture and Storage.		
	The students have basic knowledge about the principles, or	operation and design of turbomachinery		
Skills	The students will be able, using theories and methods of	the energy technology from fossil fuels and bas	sed on well-founded k	nowledge on the funct
	and construction of gas and steam power plants, to iden	tify basic associations in the production of he	at and electricity, so a	as to develop concept
	solutions. Through analysis of the problem and exposure	to the inherent interplay between heat and po	wer generation the st	udents are endowed v
	the capability and methodology to develop realistic optima	I concepts for the generation of electricity and t	ne production of heat.	From the technical bas
	the students become the ability to follow better the deliber	rations on the electricity mix composition within	the energy-political t	riangle (economy, sec
	supply and environmental protection).			
	Within the framework of the exercise the students learn th	a use of the appointing authors quite EBCII (	NI ProfessionalTM Wi	th this tool small prost
	tasks are solved with the PC, to highlight aspects of the de		on Froiessional . Wi	ir iriis toor siriali practi
	asio are solved with the FC, to highlight aspects of the de	sign and development of power plant eyeles.		
	The students are able to do simplified calculations on turbo	omachinery either as part of a plant, as single c	omponent or at stage I	evel.
Personal Competence				
Social Competence	An excursion within the framework of the lecture is planne	d for students that are interested. The students	get in this manner dir	ect contact with a mod
	power plant in this region. The students will obtain first-h	and experience with a power plant in operation	on and gain insights i	nto the conflicts between
	technical and political issues.			
Autonomy	The students assisted by the tutors will be able to develo			
	theoretical and practical knowledge from the lecture is			
	conditions highlighted. The students are able independent	ently to analyse the operational performance	of steam power plant	s and calculate selec
	quantities and characteristic curves.			
Westland in Harma	Independent Children 1440 Children Time in Leathur 70			
Workload in Hours Credit points	Independent Study Time 110, Study Time in Lecture 70			
Examination	Written exam			
Examination duration and scale	Written examination of 120 min			
Assignment for the Following	General Engineering Science (German program): Speciali	isation Energy and Environmental Engineering	Compulsory	
Curricula	General Engineering Science (German program): Speciali	**		
- Tould	General Engineering Science (German program, 7 semes	* **		ry
	General Engineering Science (German program, 7 semes	, ,	0 0 1	*
	Energy and Environmental Engineering: Core qualification		- 5, -,	
	General Engineering Science (English program): Specialis		Compulsory	
	General Engineering Science (English program): Specialis			
		_ 0,	, ,	
	General Engineering Science (English program, 7 semest	er): Specialisation Energy and Enviromental Er	gineering: Compulsor	у
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest			



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



Typ Hrs/wk	Recitation Section (large)	
Hrehul		
III 5/WK	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alfons Kather	
Language	DE	
	WiSe	
Content		
	In the 1 <sup>st</sup> 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 <sub>2</sub> emissions and the resulting climatic effects are a special focus of the lecture and	
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discussional power plants and renewable energy sources are discussional power plants.	
	and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In	
	critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for	
	responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.	
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM. With this tool small tasks	
	solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterward	
	ask questions and get feedback. The course work has a positive effect on the students final grade.	
	and quotient and get recordant. The control work has a positive effect of the challenging interesting grade.	
Literature	0.00	
	Kelida Kaft und Arbeitsmaanhinan	
	Kalide: Kraft- und Arbeitsmaschinen     Thomas H. L. Thomascha Kraftanlagen, Springer Verlag, 1995	
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985     Strauß, K.: Kraftwerketenhalt, Springer-Verlag, 2006	
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006	
	Window and Dhilingay Fraggista halls Carlingay Variage 1000	
	<ul> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis</li> </ul>	



Module M0684: Heat Transf	er			
Courses				
Title		Typ	Hrs/wk	CP
		Typ Lecture	3	4
Heat Transfer (L0458) Heat Transfer (L0459)		Recitation Section (large)	3	2
Module Responsible	Dr. Andreas Moschallski	ricollation occiton (large)		
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an a	pproach.		
Autonomy	The students are able to develop a complex problem self-consiste	nt and analyse the results in a critical wa	y. A qualified exchan	ge with other students is
	given.	•		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation N			
Curricula	General Engineering Science (German program): Specialisation N		ystems: Compulsory	
	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation N			
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering,	Focus Ineoretical N	iecnanicai Engineering:
	Compulsory	sialisation Diamadical Facilitation Com		
	General Engineering Science (German program, 7 semester): Spe		ipuisory	
	General Engineering Science (English program): Specialisation Bi General Engineering Science (English program): Specialisation M		nice: Compulsory	
	General Engineering Science (English program): Specialisation Mi General Engineering Science (English program): Specialisation Mi			
	General Engineering Science (English program): Specialisation Mi			ering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation with			
	General Engineering Science (English program, 7 semester): Spec			
	Compulsory		. 1300oronoudi IV	
	General Engineering Science (English program, 7 semester): Spec	ialisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compuls		· •	
	Mechanical Engineering: Specialisation Theoretical Mechanical En			

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



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



Module M1022: Reciprocat	ing Machinery			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0633)		Lecture	1	1
	nd Turbomachinery - Part Reciprocating Engines (L0634)	Recitation Section (large)	1	1
nternal Combustion Engines I (L0059)		Lecture	2	2
nternal Combustion Engines I (L0639)		Recitation Section (large)	1	2
Module Responsible	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous	Thermodynamics, Mechanics, Machine Elements			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Skills	machinery and describe the qualitative and quantitative correlation pumps. They are able to utilize technical terms and parameter furthermore to give an overview of charging systems, fuels and explained and operational problems.  As a result of the part module "Internal Combustion Engines I", addition, they are able to utilize their knowledge of design, meet to explain, assess and develop engines as well as charging systems. The students are skilled to employ basic and detail knowledge massess, analyse and solve technical and operational problems as	ers as well as aspects regarding the emissions. The students are able to select the students are able to select the students are able reflect and utilize the students are able to select the selec	development of powers specific types of machine state-of-the-art regions and the approach or dring computer-aided election and operation	or density and efficienthinery and assess designarding efficiency limits of similarity. They are a process design.
Personal Competence Social Competence	The students are able to communicate and cooperate in a profes			
Autonomy	The widespread scope of gained knowledge enables the studen	is to handle situations in their future profe	ession independently a	and confidently.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Energy	Systems: Compulsory	
Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineering, Fo	cus Energy Systems:	Compulsory
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Energy S	Systems: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Fo	cus Energy Systems: 0	Compulsory
	Mechanical Engineering: Specialisation Energy Systems: Compr	ulsory		



Course L0633: Fundamentals of Re	ciprocating Engines and Turbomachinery - Part Reciprocating Engines
Тур	Lecture
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	
	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 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	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Thiemann	
Language	DE	
Cycle	SoSe	
Content	The beginnings of engine development  Design of of motors  Real process calculation  Charging methods  Kinematics of the crank mechanism  Forces in the engine	
Literature	Vorlesungsskript  Übungsaufgaben mit Lösungsweg  Literaturliste	



Course L0639: Internal 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



## **Focus Aircraft Systems Engineering**

The specialization aircraft system engineering in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the Master Energy Engineering or an economical oriented master study.

Master Energy Engineering or an ec	onomical oriented master study.			
Module M0597: Advanced	Mechanical Engineering Design			
0				
Courses		T	H	0.0
Title Advanced Mechanical Engineering Design	N II (1.0364)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design	n I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	a Fundamentals of Machanical Engineering Design			
Knowledge	Fundamentals of Mechanical Engineering Design     Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
	3 11 3			
Educational Objectives	After taking part successfully, students have reached the following	wing learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	<ul> <li>explain complex working principles and functions of r</li> </ul>	nachine elements and of basic elements of flui	dics.	
	explain requirements, selection criteria, application so			
	indicate the background of dimensioning calculations		,	
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered ma	chine elements,		
	<ul> <li>transfer knowledge learned in the module to new requ</li> </ul>	uirements and tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings and sche</li> </ul>	matic sketches,		
	<ul> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in t</li> </ul>	he lecture supported by activating methods.		
Automorphis				
Autonomy	Students are able to independently deepen their acqu	ired knowledge in exercises.		
	Students are able to acquire additional knowledge	and to recapitulate poorly understood conte	ent e.g. by using the	video recordings of the
	lectures.			
Workload in Hours	Independent Study Time 68 Study Time in Lecture 112			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Credit points Examination	6 Written exam			
Credit points Examination Examination duration and scale	6 Written exam 120	tion Machanical Engineering Focus Engray S	wetame: Compulsory	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa			Compulsory
Credit points Examination Examination duration and scale	6 Written exam 120 General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sy	ystems Engineering:	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials	ystems Engineering: in Engineering Scier	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro	ystems Engineering: in Engineering Scier nics: Compulsory	nces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro	nces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretic	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine	duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretic t: Specialisation Mechanical Engineering, Foc	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E	duction: Compulsory eering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretic t: Specialisation Mechanical Engineering, Foc	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E	duction: Compulsory eering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Foc ster): Specialisation Mechanical Engineering	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E I, Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulson n Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Pocus Materials Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation M	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E I, Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor n Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester Compulsory	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Materials Specialisation Mechanical Engineering, Pocus Materials Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation M	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E I, Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor n Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program)	tion Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering, Focus	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretics: Specialisation Mechanical Engineering, Focus Theoretics (Ster): Specialisation Mechanical Engineering, Focus Focus Theoretics (Specialisation Mechanical Engineering, Focus Theoretics): Specialisation Mechanical Engineering, Focus Theoretics (Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Me	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E I, Focus Materials in us Mechatronics: Cor Focus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment and Production Mechanical Engineerin
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semest Compulsory  General Engineering Science (German program, 7 semest Compulsory  General Engineering Science (German program, 7 semest Compulsory  General Engineering Science (German program, 7 semester Compulsory	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Mechanica	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E I, Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical N us Biomechanics: Co	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso n Engineering Science mpulsory lopment and Production Mechanical Engineerin mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program)	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation Mechanical Engineering Specialisation Mechanical Engineering Sp	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical N us Biomechanics: Cous us Energy Systems: Cous science Signature Science science Science Science science Signature Science sc	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso n Engineering Science mpulsory lopment and Production Mechanical Engineerin mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semest Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Energy Syton Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Engineering, Focus Engineering	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical N us Biomechanics: Co us Energy Systems: Co stems: Compulsory	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso n Engineering Science mpulsory lopment and Production Mechanical Engineerin mpulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program): Specialisat General Engineering Science (English program): Specialisat	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Energy Sytion Mechanical Engineering, Focus Aircraft Sytion Mech	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: Co stems: Compulsory stems Engineering: Co	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso n Engineering Science mpulsory lopment and Productio Mechanical Engineerin mpulsory Compulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program): Specialisat General Engineering Science (English program): Specialisat General Engineering Science (English program): Specialisat	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Energy Sytion Mechanical Engineering, Focus Materials Ingineering, Focus Materials Engineering, Focus Materials Engineering, Focus Materials	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Ci in Engineering Scien	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor n Engineering Science mpulsory lopment and Productio Mechanical Engineerin mpulsory Compulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program): Specialisat	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatrotion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials iton Mechanical Engineering, Focus Materials iton Mechanical Engineering, Focus Mechanical Engi	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Ci in Engineering Scien nics: Compulsory	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor n Engineering Science mpulsory lopment and Productio Mechanical Engineerin mpulsory Compulsory Compulsory Compulsory ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semest Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program): Specialisat	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Ditart Mechanical Engineering, Focus Product Ditart Systems (1998)	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: C stems: Compulsory stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proce	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dopment and Production mpulsory Compulsory Compulsory Compulsory duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program): Sp	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials in Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretical Engineering, Foc	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E in, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: C rstems: Compulsory stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Pro al Mechanical Engine	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dopment and Production mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat General Engineering Science (English program): S	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials in Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretical Especialisation Mechanical Engineering, Focus Theoretical Engineerin	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E in, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: Co restems: Compulsory stems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Pro al Mechanical Engine us Aircraft Systems Er	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat General Engineering Science (English program): S	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials in Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretical Especialisation Mechanical Engineering, Focus Theoretical Engineerin	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E in, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical N us Biomechanics: Co us Energy Systems: Co restems: Compulsory stems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Pro al Mechanical Engine us Aircraft Systems Er	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor n Engineering Science dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat Compulsory	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials in Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Dition Mechanical Engineering, Focus Theoretical Specialisation Mechanical E	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical N us Biomechanics: Co us Energy Systems: Co restems: Compulsory stems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er procus Materials in	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory ngineering: Compulsory ngineering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat General Engineering Science (English program, 7 semester)	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Product Deter): Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Theoretical Engineering, F	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Con Focus Theoretical N us Biomechanics: Co us Energy Systems: Co ystems: Compulsory istems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Con	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory ngineering: Compulsory ngineering: Compulsory ngineering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program): Specialisat General Engineering Science (English program, 7 semester)	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Product Deter): Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Theoretical Engineering, F	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Con Focus Theoretical N us Biomechanics: Co us Energy Systems: Co restems: Compulsory restems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Con	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ingineering: Compulsory deepering: Compulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory direction: Compulsory decing: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester Compulsory  General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester General Engineering Science (English program): Specialisat General Engineering Science (English program, 7 semester)	tion Mechanical Engineering, Focus Aircraft Sytion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ster): Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Theoretical Engineerin	ystems Engineering: in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Product Devel Focus Theoretical N us Biomechanics: Co us Energy Systems: C restems: Compulsory restems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er procus Materials in us Mechatronics: Con Focus Product Devel	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory opment and Production



Compulsory

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

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

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



Course L0262: Advanced Mechanic	al Engineering Design I
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Design Facility
	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     Clidian box data
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	<ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	<ul> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> </ul>
	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
	Sowie waltere bucher zu spezierien i flettiett

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



lechanical Design Project
rechanical Design Project
Typ Hrs/wk CP
Practical Course 4 6
Prof. Dieter Krause
None
Mechanical Engineering: Design
Advanced Mechanical Engineering Design
After taking part successfully, students have reached the following learning results
After passing the module, students are able to:
express the procedure for systematically handling of
• complex design tasks ,
describe working principles, their use and combination possibilities,
explain guidelines for designing for function and manufacturing,
explain advanced use-oriented knowledge of machine elements.
After a series the sendule students are able to
After passing the module, students are able to:
<ul> <li>analyze complex tasks and develop principle solutions using sketches,</li> </ul>
convert principle solutions into a detailed design,
<ul> <li>use methods to design and solve engineering design tasks systematically and solution-oriented,</li> </ul>
<ul> <li>create a technical documentation including all necessary technical drawings to understand the functions of the system,</li> </ul>
document calculations of selected machine elements clearly and in detail.
After passing the module, students are able to:
<ul> <li>present and discuss solutions and technical drawings within groups,</li> </ul>
reflect the own results in the work groups of the course
After passing the module, students are able to:
<ul> <li>independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,</li> </ul>
to independently solve problems.
Independent Study Time 124, Study Time in Lecture 56
6
Written exam
180
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productior
Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production



Course L0266: Advanced Mechanical Design Project		
Тур	Practical Course	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff, 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	
	<ul> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> </ul>	
	<ul> <li>Erstellung einer ausführlichen Dokumentation</li> </ul>	
	Lösungsfindung	
	<ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> </ul>	
	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	



Module M1320: Simulation	and Design of Mechatronic Systems			
Courses				
Title		Тур	Hrs/wk	CP
Simulation and Design of Mechatronic Sys	tems (I.1822)	Lecture	2	2
Simulation and Design of Mechatronic Sys		Laboratory	1	2
Simulation and Design of Mechatronic Sys	tems (L1823)	Recitation Section (large)	1	2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and electrical engin	neering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for des	ign, modeling, simulation and optimization	of mechatronic system	ns.
Skills	Students are able to apply modern algorithms for modeling	of mechatronic systems. They can identi	fy, simulate and desi	ign simple systems and
	implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups a	and present results to target groups.		
Autonomy	Students are able to recognize and improve knowledge deficits	independently.		
	With instructor assistance, students are able to evaluate their ov	wn knowledge level and define a further cou	irse of study.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Mechanical Engineering, Focus Mechatro	onics: Compulsory	
Curricula	General Engineering Science (German program): Specialisatio	n Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (German program): Specialisatio	n Mechanical Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical Engineering, Foo	cus Mechatronics: Con	npulsory
	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compulsory
	General Engineering Science (German program, 7 semester	:): Specialisation Mechanical Engineering.	Focus Theoretical N	Mechanical Engineering:
	Elective Compulsory	, ,		0 0
		n Mechanical Engineering, Focus Aircraft Sy	vstems Engineering: C	Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechanical Engineering: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory			
		* *	-	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: 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 Theoretical Mechanical Engineering:			
	Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory			
	Mechanical Engineering: Specialisation Mechatronics: Compul			
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanica	•		
	Mechatronics: Core qualification: Compulsory	a Engineering. Compulsory		
	Medial office. Our quantication. Compulsory			

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



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

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



Module M0599: Integrated I	Product Development and Lightweight Desig	jn		
Courses				
Title		Тур	Hrs/wk	CP
CAE-Team Project (L0271)		Problem-based Learning	2	2
Development of Lightweight Design Produ	cts (L0270)	Lecture	2	2
Integrated Product Development I (L0269)		Lecture	2	2
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Advanced Knowledge about engineering design:			
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence	After a small strength a mandal a strategy of the strategy of			
Knowledge	After completing the module, students are capable of:			
	<ul> <li>explaining the functional principle of 3D-CAD-System</li> <li>describing the interaction of the different CAE-System</li> </ul>			
CI:II-	describing the interaction of the different OAL-Oysten	is in the product development process		
Skills				
	After completing the module, students are able to:			
	evaluate different CAD- and PDM-Systems with regar     design an exemplary product using CAD-,PDM- and/		ication schemes and	product structuring
Personal Competence				
Social Competence	After completing the module, students are able to:			
	<ul> <li>To develop a project plan and allocate work appropri</li> </ul>	ate work packages in the framework of group	discussions	
	Present project results as a team for instance in a pre			
Autonomy	Students are capable of:			
	<ul> <li>independently adapt to a CAE-Tool and complete a g</li> </ul>	iven practical task with it		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
Curricula	General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Product D	Development and Pro	duction: Compulsory
	General Engineering Science (German program, 7 semester	): Specialisation Mechanical Engineering, Foo	us Aircraft Systems E	ngineering: Compulsory
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineering,	Focus Product Devel	opment and Production
	Compulsory			
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat		·	
	General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester	1 0 0,	,	0 0 1 ,
	Compulsory	o.,. oposianouson moonamear Engineering,	SSAS FIGURE DEVEL	opon and I loudelloll
	Mechanical Engineering: Specialisation Product Developme	nt and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems Eng	gineering: Compulsory		
	Product Development, Materials and Production: Technical C	Complementary Course Core Studies: Elective	Compulsory	



Course L0271: CAE-Team Project	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul> <li>Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)</li> <li>Team formation, allocation of tasks and generation of a project plan</li> <li>Collective creation of one product out of CAD models supported by FEM calculations and PDM system</li> <li>Manufacturing of selected parts using 3D printer</li> <li>Presentation of results</li> </ul> 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 Ligh	ntweight Design Products
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul> <li>Lightweight design materials</li> <li>Product development process for lightweight structures</li> <li>Dimensioning of lightweight structures</li> </ul>
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> </ul>

Course L0269: Integrated Product Development I		
Тур	Lecture	
Hrs/wk	2	
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	<ul> <li>Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag</li> <li>Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles</li> <li>Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag</li> <li>Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag</li> <li>Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag</li> </ul>	



Module M0767: Aeronautic	al Systems			
	<u> </u>			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Aircraft Systems (L0741)		Lecture	2	2
Fundamentals of Aircraft Systems (L0742)		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 thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic			
-	knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.			
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system			
	implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the			
	context of the overall system.			
Personal Competence				
Social Competence	Students are made aware of interdisciplinary communication in groups.			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		-	
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following				
Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory			
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program, 7 semester):	* *		
	Logistics and Mobility: Specialisation Logistics and Mobility: E	,		
	Mechanical Engineering: Specialisation Aircraft Systems Eng			
	3 3 -p			

Course L0741: Fundamentals of Air	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 Transportation Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	SoSe	
Content	1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air traffic management 9. Environmental aspects of air transportation 10. Future perspectives of air transport	
Literature	<ol> <li>V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5</li> <li>H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003</li> <li>K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0</li> <li>I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5</li> <li>D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3</li> <li>N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4</li> <li>P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8</li> <li>H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0</li> </ol>	

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



## **Focus Materials in Engineering Sciences**

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

technological problems.				
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering Design	n II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design	n II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering Design	n I (L0262)	Lecture	2	2
Advanced Mechanical Engineering Design	n I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
Professional Competence				
Knowledge	After passing the module students are able to:			
Knowieage	After passing the module, students are able to:			
	explain complex working principles and functions of	of machine elements and of basic elements of flui	idics,	
	explain requirements, selection criteria, application	n scenarios and practical examples of complex m	achine elements,	
	indicate the background of dimensioning calculation	ons.		
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered in	machine elements,		
	transfer knowledge learned in the module to new r			
	recognize the content of technical drawings and so			
	evaluate complex designs, technically.			
Personal Competence				
Social Competence	Charles are also to discuss to the circles for months			
	Students are able to discuss technical information	in the recture supported by activating methods.		
Autonomy				
	Students are able to independently deepen their a			
	Students are able to acquire additional knowled	ge and to recapitulate poorly understood conte	ant e.g. by using the	video recordings of the
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
		ination Machanical Engineering Facus Energy C	Vyatama: Campulaani	
Assignment for the Following	General Engineering Science (German program): Special			0
Curricula	General Engineering Science (German program): Special General Engineering Science (German program): Special			
				ices. Compulsory
	General Engineering Science (German program): Special General Engineering Science (German program): Special			duation: Compulary
	General Engineering Science (German program): Special	0 0,	•	. ,
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 series			
	Compulsory	mester). Opeciansation Mechanical Engineering	j, i ocus Materiais III	Linginiceting ocienices.
	General Engineering Science (German program, 7 semes	tor): Specialization Machanical Engineering, Foo	ous Mochatronics: Cou	nnulcon
	General Engineering Science (German program, 7 semi-			
	Compulsory	ester). Opecialisation Mechanical Engineering,	1 ocus i loudet Devel	opinent and i roddeton.
	General Engineering Science (German program, 7 sem	pactor): Specialization Machanical Engineering	Ecous Theoretical I	Acchanical Engineering:
	Compulsory	iester). Specialisation Mechanical Engineering,	Tocus Theoretical I	viechanical Engineening.
	General Engineering Science (German program, 7 semes	ter): Specialization Mechanical Engineering Foo	rue Biomachanice: Co	mnuleon
	General Engineering Science (German program, 7 semes	, ·		
	General Engineering Science (German program): Speciali	, ·		Jonipulsory
	General Engineering Science (English program): Speciali			Compulsory
	General Engineering Science (English program): Speciali			
			-	ooo. Oompulsory
	General Engineering Science (English program): Speciali			Justian: Campulater:
	General Engineering Science (English program): Speciali			
	General Engineering Science (English program): Speciali	* *	-	
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engineering	J, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engineering,	Focus Product Devel	opment and Production:
	1			



Compulsory

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

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

Naval Architecture. Core qualification. Compulsor

Course L0264: Advanced Mechanic	al 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)	
	Calculations of hydrostatic systems (fluidics)	
Literature	Dubbal Tasabanhush für den Masabinanhau Crate K. H. Faldhusen, 1/1/22 V. Chinney V. Anders altitude Auflern	
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.      Maschinenselemente, Bend I. III: Niemens, C., Springer, Verlag, aktuelle Auflage.	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.      Maschinen und Kenstruktionselemente: Steinbilger, W. Päner, P. Springer Verlag, aktuelle Auflage.	
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.      Fieführung in die DIN Norman Klein M. Taubage Verlag.	
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Monetruktionslohen Rohl, G., Beitz, W., Springer, Verlag, elektrolle Auflage.      Monetruktionslohen Rohl, G., Beitz, W., Springer, Verlag, elektrolle Auflage.	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.      Magabigggelement at 2: Spheoth R. Regress Verlag, aktuelle Auflage.      Magabigggelement at 2: Spheoth R. Regress Verlag, aktuelle Auflage.	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.      Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.      Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      Del ("Match Maschine adaptated Million In March In	
	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



Course L0262: Advanced Mechanic	al Engineering Design I		
	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	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:		
	Calculation methods of the following machine elements:      Linear relling begrings.		
	<ul><li>Linear rolling bearings</li><li>Axes &amp; shafts</li></ul>		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank gears     Cliding begings		
	Sliding bearings     Calculations of hydrostatic systems (fluidics)		
	• Calculations of Hydrostatic systems (indicis)		
Literature	Dubbel Teacherhark (Tealer Marchinerham) Orde V. H. Faldharen, 1912 V. O. Array Materials (H. A. Gara		
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.      Maschine alle Auflage.		
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.		
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.  Til Til Land Line (1998) Auf Technology (1998)		
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.  Kanthali and Bakhan Bak		
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.  Machine den vis 4.0.0 chloris B. Brown Make et al. M. A. flore.  Machine de november 1.0.0 chloris B. Brown Make et al. M. A. flore.		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      The second of the second		
	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



Module M0988: Structural N	Materials			
modulo modo. otractarari	indo indo			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Mechanical Properties of	Materials (L1090)	Lecture	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are re-	sponsible for the mechanical behaviour of metals.	They acquire basic knowl	egde in modelling of the
	materials behaviour. Furthermore, the students lea	rn about the behaviour of metals under static and	dynamic loads. The stude	nts get to know the most
	important welding technologies and the correspond	ling systems. They learn about the influence of wel	ding on the materials and	design.
Skills	The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding			
Okino	behaviour of steel materials.	netals and the underlying principles. They are ab	ie to name the mildenem	g lactors on the welding
	The students are able to select between alloys ac	* ' '		-
	welding techniques and select the suitable technic	que and system components for a defined applicat	ion. They are able to dime	ension weld joints within
	design tasks.			
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): S	Specialisation Mechanical Engineering, Focus Mate	rials in Engineering Scier	ices: Compulsory
Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanical Engine	ering, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): S	pecialisation Mechanical Engineering, Focus Mate	rials in Engineering Scien	ces: Compulsory
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Engine	ering, Focus Materials in	Engineering Sciences:
	Compulsory			
	Mechanical Engineering: Specialisation Materials i	n Engineering Sciences: Compulsory		

Course L1090: Fundamentals of Mechanical Properties of Materials		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Norbert Huber, Dr. Erica Lilleodden	
Language	EN	
Cycle	SoSe	
Content	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 Technology	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	DE
Cycle	WiSe
Content	- phase transitions, phase diagrams and thermal activated processes
	- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
	- structure and properties of non-ferrite metals (aluminum, titanium)
	- NDT/DT Methods for materials and welds
	- gas fusion welding, fundamentals of electric arc welding technologies
	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding
	- resistance welding/ polymer welding/ hybrid-welding
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl.
	Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.



Module M0662: Numerical	Mathematics I			
Courses				
Title		Тур	Hrs/wk	CP
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematik I + II for Engineering Students (german or er     basic MATLAB knowledge	nglish) <b>or</b> Analysis & Linear Algebra I + II for	Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration, explain their core ideas,     repeat convergence statements for the numerical metho     explain aspects for the practical execution of numerical in	ds,		finding problems and to
Skills	Students are able to			
	implement, apply and compare numerical methods using the convergence habout the formation methods.		a o rith m	
	<ul> <li>justify the convergence behaviour of numerical methods</li> <li>select and execute a suitable solution approach for a given</li> </ul>		gorithm,	
Personal Competence				
Social Competence	Students are able to			
	<ul> <li>work together in heterogeneously composed teams (i.e. foundations and support each other with practical aspec</li> </ul>			edge), explain theoretical
Autonomy	Students are capable			
,	to assess whether the supporting theoretical and practic     to assess their individual progess and, if necessary, to a		or in a team,	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisation		anics: Compulsory	
	General Engineering Science (German program): Specialisation	* *		nces: Compulsory
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): S	Specialisation Computer Science: Compulso	ory	
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engineering	, Focus Materials in	Engineering Sciences
	Compulsory			
	General Engineering Science (German program, 7 semester): S	Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical Engineering, Foc	us Biomechanics: Co	mpulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess	Engineering: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics:	Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		unioni Commuter	
	General Engineering Science (English program): Specialisation			oos: Compulsory
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S			ces. Compulsory
	General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester		•	Engineering Sciences
	Compulsory	,. oposiansanon mechanical Engineering	, i ocus ivialeriais II	Linginisering Sciences
	General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engineering, Focu	us Biomechanics: Co	mpulsory
	Computational Science and Engineering: Core qualification: Co			
	Process Engineering: Specialisation Process Engineering: Elec	tive 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, Dr. Patricio Farrell	
Language	DE/EN	
Cycle	WiSe	
Content	<ol> <li>Error analysis: Number representation, error types, conditioning and stability</li> <li>Interpolation: polynomial and spline interpolation</li> <li>Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas</li> <li>Linear systems: LU and Cholesky factorization, matrix norms, conditioning</li> <li>Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization</li> <li>Eigenvalue problems: power iteration, inverse iteration, QR algorithm</li> <li>Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems</li> </ol>	
Literature	<ul> <li>Stoer/Bulirsch: Numerische Mathematik 1, Springer</li> <li>Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer</li> </ul>	

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



Module M1009: Material Sci	ience Laboratory			
Courses				
Title		Тур	Hrs/wk	CP
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)	D (D   E	Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler none			
Admission Requirements  Recommended Previous	none			
Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
· · · · · · · · · · · · · · · · · · ·	After taking part successionly, students have reached the following	learning results		
Professional Competence  Knowledge	Students are able to give a summary of the technical details of exp	poriments in the area of materials sais	noos and illustrato rooms	otivo rolationshins They
Knowieage	are capable of describing and communicating relevant problem		·	
	process of solving practical problems and present related results.	s and questions using appropriate te	cillical language. They	can explain the typical
	process or solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on mater	ial sciences to the process of solving	practical problems. The	y identify and overcome
	typical problems during the realization of experiments in the conte	xt of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to conduc	ct experiments in the context of materi	als sciences. They are a	ble to effectively present
codal competence	and explain their results alone or in groups in front of a qualified a	·	ars soronocs. They are a	old to chicotively present
	3.14			
Autonomy	Students are capable of solving problems in the context of mater		re. They are able to fill g	aps in as well as extent
	their knowledge using the literature and other sources provided by	the supervisor.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Colloquium			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson			
Assignment for the Following	General Engineering Science (German program): Specialisation M	Mechanical Engineering, Focus Materi	als in Engineering Scien	ces: Compulsory
Curricula	General Engineering Science (German program): Specialisation M	Mechanical Engineering, Focus Produ	ct Development and Proc	duction: Compulsory
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineer	ring, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	Compulsory	15 1 1 0 1		
	Mechanical Engineering: Specialisation Product Development and			
	Mechanical Engineering: Specialisation Materials in Engineering	• •	ina Campula i i	
	Product Development, Materials and Production: Technical Comp	iementary Course Core Studies: Electi	ive Compulsory	

Course L1088: Companion Lecture	for Materials Science Laboratory
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	WiSe
Content	Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are
	indicated in brackets for each experiment:
	1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)
	2. notch impact test (elastic properties of solids)
	3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)
	4. tensile test (elastic properties of solids)
	5. Identificiation of polymers (polymer physics)
	6. fiber-reinforced polymers (physical principles of composite materials)
	7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)
	8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)
	William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007)



Course L1235: Material Science Laboratory	
Тур	Laboratory Course
Hrs/wk	4
CP	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	8 Versuche:
	Zustandsdiagramm, Wärmebehandlung, Härtemessung
	Kerbschlagbiegeversuch
	Vorgänge bei der Erstarrung von Metallen
	Zugversuch
	Identifizierung von Kunststoffen
	Faserverstärkte Kunststoffe
	Herstellung und Gefüge keramischer Werkstoffe
	Mechanisches Verhalten keramischer Werkstoffe
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II





Course L1233: Enhanced Fundamentals: Ceramics and Polymers		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	1. Einführung	
	Natürliche "Keramiken" - Steine	
	"Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik	
	2. Pulverherstellung	
	Einteilung der Pulversyntheseverfahren	
	Der Bayer-Prozess zur Al2O3-Herstellung	
	Der Acheson-Prozess zur SiC-Herstellung	
	Chemical Vapour Deposition	
	Pulveraufbereitung	
	Mahltechnik	
	Sprühtrockner	
	3. Formgebung	
	Arten der Formgebung	
	Pressen (0 - 15 % Feuchte)	
	Gießen (> 25 % Feuchte)	
	Plastische Formgebung (15 - 25 % Feuchte)	
	4. Sintern	
	Triebkraft des Sinterns	
	Effekt von gekrümmten Oberflächen und Diffusionswegen	
	Sinterstadien des isothermen Festphasensinterns	
	Herring scaling laws Heißisostatisches Pressen	
	Mechanische Eigenschaften von Keramiken	
	The first and a least above. Materials and alter-	
	Elastisches und plastisches Materialverhalten  Bruchzähigkeit - Linear-elastische Bruchmechanik	
	Festigkeit - Festigkeitsstreuung	
	6. Elektrische Eigenschaften von Keramiken	
	Ferroelektische Keramiken	
	Piezo-, ferroelektrische Materialeigenschaften Anwendungen	
	Keramische lonenleiter	
	Ionische Leitfähigkeit	
	Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde	
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier	
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975	
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998	
	D. Munz, T. Fett, Ceramics, Springer, 2001	
	Polymerwerkstoffe	
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;	
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €	
	Kunststoffphysik	
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €	
	Werkstoffkunde Kunststoffe	
	G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €	
	Kunststoff-Kompendium	
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €	



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

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



## **Focus Mechatronics**

The specialization Mechatronics in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Mechatronics or an economical oriented master study.

	Mechatronics or an economical orie	nted master study.			-
Advanced Mechanical Equipment (pulsips) II 20019   Manage 2   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Medical Responsible (Prof. College Foreignee)  Administration Requirements A Membranical Equipment (pulsips) II 20019   Relatation (tags)   Relatation (tags	Module M0597: Advanced	Mechanical Engineering Design			
Advanced Mechanical Equipment (pulsips) II 20019   Manage 2   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Advanced Mechanical Equipment (pulsips) II 20019   Relatation Section (tags)   2   1   Medical Responsible (Prof. College Foreignee)  Administration Requirements A Membranical Equipment (pulsips) II 20019   Relatation (tags)   Relatation (tags					
Abstance Management (pages) (LLBSD)  Admission Registration (pages) (LLBSD)  For District Kindson  Admission Registration (pages) (LLBSD)  For District Kindson  Admission Registration (pages)  For District Kindson  For Control Management  Recommended Previous  Professional Competence  Professional Competence  Professional Competence  Advanced Previous  After taking part successfully, students have reached the following learning wearlis  For Laborational Objectives  Professional Competence  Advanced Previous  After pages of the module, students as abit to:  - explain complex verifies principles and functions of Invations and of beasing elements of fluidics, - explain complex verifies principles and functions of Invations and pages of complex read time elements, - incides the bearing and advanced or office and pages of complex read time elements, - incides the bearing additional control of Invations and the service of complex read time elements, - incides the bearing additional control of Invations and the service of complex read time elements, - incides the bearing additional control of invations and trains a train of the service and provided examples of complex read time elements, - incides the bearing additional control of invations and trains and trains provided examples of complex read time elements, - incides the bearing and distinctions of covered machine elements and take provided examples of complex read time elements, - incides the bearing and distinctions of covered machine elements and trains	Courses				
Advanced Normania Equipments (Marchael (Marcha	Title		Тур	Hrs/wk	CP
Manusche Mentane (Taylerening Design) (Libbe)  Module Responsible (Manusche Mentane (Taylerening Design)  Module Responsible (Manusche Mentane (Manusche Mentane)  Recommended Previous  Recommended Previous  Recommended Previous  Admission Requirements Inc.  Publication (Materials Educational Objectives)  - Full distinctibility of Materials Education  - Full distinctibility of Materials  - Full dis	Advanced Mechanical Engineering Design	n II (L0264)	Lecture	2	2
Mechanistic Responsible Processor (Listato)  Mechanistic Responsible Processor (Listato)  More Recommended Processor  Knowledge  Findermanistic Materials Science  Professional Cognetioner  Recommended Dejective  Findermanistic Materials Science  Professional Cognetioner  Recommended Dejective  Professional Cognetioner  Recommended Dejective  Professional Competence  Recommended Professional Competence  Findermanistic Materials Science (Listato on Cognetic Professional Competence)  Professional Competence  Recommended Professional Competence  Professional Competence  Recommended Professional Competence  Professional Competence  Are passing the module, adudents are able to:  **equal mechanisms of the module o	Advanced Mechanical Engineering Design	n II (L0265)	Recitation Section (large)	2	1
Motion Responsible Admission Regulationates Recommunication Provisions Knowledge - Furdamental of Mechanical Engineering Design - Activations - Furdamental of Mechanical Engineering Design - Activations - Furdamental Objectives - Furdamental Obje					2
Admission flagularements  Processing Personal  Knowledge  ** Fundamentals of Mechanical Engineering Design  ** Fundamental of Mechanical Engineering Design  ** Fundamental of Mechanical Engineering Design  ** Fundamental of Mechanical Engineering Design  ** Professional Objectives  ** explain complete, subdicts are able to:  ** explain programmental Engineering Engineering and Softwards of Engineering Engineering Design  ** explain the Engineering Engineering Engineering Engineering Design  ** explain the Engineering Engin	Advanced Mechanical Engineering Design	1 (L0263)	Recitation Section (large)	2	1
Recommended Previous  Revolution  Fundamentals of Mechanical Engineering Design  Authorized  Fundamentals of Mechanical Engineering  Estatational Objective  Protestorial Competitions  Revolution  Revolution  Fundamental of Methanical Engineering  Bernard Competitions  Revolution  Alter being part successfully, subdimes have reached the following learning results  Protestorial Competitions  Revolution  Alter passing the module, students are able to:  - engial requirements, execution reflects, application somerors and practical examples of complex machine elements,  - indicate the bedragment of fermedicining calculations or manchine elements and or basic elements of fluidics,  - engial regularments, execution reflects, application somerors and practical examples of complex machine elements,  - indicate the bedragment of fermedicining calculations  - engial regularments, execution of the enducid to the new requirements and sake (problem solving skills),  - recognize the centers of inschricted intermetation in the lecture supported by adherent greathors.  - enducine complex continues of the module to the new requirements and sake (problem solving skills),  - recognize the centers of inschricted intermetation in the lecture supported by adherent greathors.  - Students are able to discuss technical information in the lecture supported by adherent greathors.  - Students are able to explain additional knowledge and to recognize the poorly understood content of g by using the video recognings of the interies.  - Students are able to explain additional knowledge and to recognize the poorly understood content of g by using the video recognings of the interies.  - Students are able to explain a student students of the poorly understood content of g by using the video recognings of the interies.  - Students are able to explain a students of the poorly understood content of g by using the video recognings of the interies.  - Students are able to explain	Module Responsible	Prof. Dieter Krause			
Fundamentals of Mechanical Engineering Design     Fundamentals of Mechanical Engineering Design     Fundamentals of Mechanical Engineering     Professional Competence     Professional Competence     Revention and professional Competence     Professional Competence     Professional Competence     Indicate the background of differentiation and braid professional competence and professional competence and of the translational competence and of differentiation and professional professional competence and of differentiation and professional professional professional competence and of differentiation and professional professional competence and of differentiation and professional professional professional developments and professional professional professional professional developments and professional professio	Admission Requirements	None			
**Monthanics**  **Professional Objective**  **Professional Competence**  *	Recommended Previous	Fundamentals of Mechanical Engineering Design			
Educational Objectiva:  Professional Competence  Professional Competence  Microslogo  Authority  Authority  Authority  Personal Competence  **Competence  **Control Competence  **Sudients are able to discuss technical information in the lackure supported by activating methods.  **Sudients are able to independently design and the method by activating methods.  **Sudients are able to acquire additional knowledge and to receptivate profity understood content e.g. by using the video recordings of It lectures.  **Workload in Hour Information and scale to acquire additional knowledge and to receptivate profity understood content e.g. by using the video recordings of It lectures.  **Caramistoria and scale to acquire additional knowledge and to receptivate profity understood content e.g. by using the video recordings of It lectures.  **Caramistoria and scale to acquire additional knowledge and to receptivate profity understood content e.g. by using the video recordings of It lectures.  **Caramistoria and scale to acquire additional knowledge and to receptivate profity understood content e.g. by using the video recordings of It lectures.  **Caramistoria and scale to acquire additional knowledge and to receptivate property understood content e.g. by using the video recordings of It lectures.  **Caramistoria and scale to acquire and profit in acquire and knowledge and to receptivate	Knowledge				
Educational Objectives  Professional Competence Notiveledge  After passing the module, students are safe to:  - explain requirements, sendious critical supplications sentances and practical examples of complex machine elements, - indicates the biologica and of machine elements and of basic elements of fluidics, - explain requirements, sendious criticals, applications sentances and practical examples of complex machine elements, - indicates the biologication of dimensioning calculations.  - Statistics - indicates the biologication of dimensioning calculations of covered machine elements, - indicates the biologication of dimensioning calculations of covered machine elements, - indicates the biologication of dimensioning and schematics sendings indicates the biologication of dimensioning and schematics sendings indicates the biologication of convered machine elements, - indicates the biologication of dimensioning and schematics sendings indicates the sendings of the converting and schematics sendings indicates the sendings of the converting and schematics sendings indicates the converting of the converting and schematics sendings indicates are able to indicate dimensioning and schematics sendings indicates are able to indicate dimensioning and schematics sendings indicates the sendings of the sendings of the schematics indicates the sending					
Professional Competence Nicoverlogie Professional Competence Nicoverlogie Alter passing the module, students are state to:  - explain compliance special competence - competence - students are state for the competence - competence - Social Compete					
Protessional Competence  Alter passing the module, students are able to:  - explain complex working principles and functions of machine elements and or basic elements of fluidos, - explain requirements, selection collecties, application searcies and practical examples of complex machine elements, - incloses the background of dimensioning calculations.  Silutor  Alter passing the module, students are able to: - accomplish dimensioning calculations of covered machine elements transfer knowledge learned in the module silutions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements transfer knowledge learned in the module discussions of covered machine elements Students are able to independently deepen their acquired knowledge in exercises Students are able to acquire additional knowledge and to recopitulate poorly understood content e.g. by using the video recordings of the following covered to the following study Time 68. Study Time in Lecture 112  Credit points    Worklead in Hours    Worklead in Hours    Worklead in Hours    Independent Study Time 68. Study Time in Lecture 112  Credit points    Stammination division and scale    Independent Study Time 68. Study Time in Lecture 112  Credit points    Assignment for the Following    Curricular    Curricular    Carried Following    Curricular    General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems Engineering Computory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Computory General Engineering Science (German program, 7 semester): Specialisation M		3 11 3			
Alter passing the module, students are able to:	Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
	Professional Competence				
e replair requirements, selection reflects, applications convarious and practicual examples of compilex machine elements, indicate the background of dimensioning calculations.  Statis  After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer involvedge learned in the module to new requirements and tasks (problem solving skills), recognize the confirm of technical disvange and schematic selecthes, valuate complex designs, technically.  Personal Competence  Social Competence  Social Competence  Social Competence  Social Competence  - Students are able to discuss technically information in the locture supported by activating methods.  - Students are able to independently deepen their acquired knowledge in exercises Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the focuses.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to dis	Knowledge	After passing the module, students are able to:			
e replair requirements, selection reflects, applications convarious and practicual examples of compilex machine elements, indicate the background of dimensioning calculations.  Statis  After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer involvedge learned in the module to new requirements and tasks (problem solving skills), recognize the confirm of technical disvange and schematic selecthes, valuate complex designs, technically.  Personal Competence  Social Competence  Social Competence  Social Competence  Social Competence  - Students are able to discuss technically information in the locture supported by activating methods.  - Students are able to independently deepen their acquired knowledge in exercises Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the focuses.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to independently deepen their acquired knowledge in exercises.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technical information in the locture supported by activating methods.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to discuss technically deepen their acquired knowledge in exercises.  - Students are able to dis			alamanta and afficient alamanta affilia	1.11	
Indicate the background of dimensioning calculations.   Skills					
Author passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical strivings and schematic sketches, recognize the content of technical strivings and schematic sketches, recognize the content of technical strivings and schematic sketches, revaluate complex designs, sechnically.  Personal Competence  Social Competence  Social Competence  Social Competence  Students are able to independently deepen their acquired knowledge in exercises. Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the features.  Workload in Hours  Credit points  Examination  Written exam  Examination Ministen and scale 1:00  Curricula  Assignment for the Following  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Computsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Computsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Computsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Computsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Computsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Computsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Computsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus P			and practical examples of complex in	achine elements,	
accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), trecognize the content of etherical stavings and schematic sketches, tevaluate complex designs, technically.  Personal Competence  Social Competence  Soc		Indicate the background of differsioning calculations.			
transfer knowledge learned in the module to new requirements and tasks (problem solving skills),     recognize the content of lecthrical drawings and schematic skelches,     evaluate complex designs, technically:      Social Competence  Autonomy      Students are able to discuss technical information in the lecture supported by activating methods.      Students are able to independently deepen their acquired knowledge in exercises.     Students are able to acquire additional knowledge and to receptivate poorly understood content e.g. by using the video recordings of the lectures.  Workload in Hours      Independent Study Time 68, Study Time in Lecture 112  Credit points      Examination  Examination duration and scale  Assignment for the Following  Curricula  Assignment for the Following  Curricula  Curricula  Assignment for the Following  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircral Systems Engineering: Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Compulsory  General Engineering Science (German program): Specialisat	Skills	After passing the module, students are able to:			
transfer knowledge learned in the module to new requirements and tasks (problem solving skills),     recognize the content of lecthrical drawings and schematic skelches,     evaluate complex designs, technically:      Social Competence  Autonomy      Students are able to discuss technical information in the lecture supported by activating methods.      Students are able to independently deepen their acquired knowledge in exercises.     Students are able to acquire additional knowledge and to receptivate poorly understood content e.g. by using the video recordings of the lectures.  Workload in Hours      Independent Study Time 68, Study Time in Lecture 112  Credit points      Examination  Examination duration and scale  Assignment for the Following  Curricula  Assignment for the Following  Curricula  Curricula  Assignment for the Following  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircral Systems Engineering: Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Compulsory  General Engineering Science (German program): Specialisat					
Personal Competence Social Competence  Autonomy  Students are able to discuss technical information in the lecture supported by activating methods.  Autonomy  Students are able to discuss technical information in the lecture supported by activating methods.  Students are able to discuss technical information in the lecture supported by activating methods.  Students are able to acquirie additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.  Workload in Hours  Independent Study Time 68, Study Time in Lecture 112  Credit points  Examination  Written exam  Examination  Milities exam  Examination duration and scale 120  Assignment for the Following  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering, Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Science Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical					
Personal Competence Social Competence Social Competence Social Competence  Authoropy  - Students are able to discuss technical information in the lecture supported by activating methods.  - Students are able to discuss technical information in the lecture supported by activating methods.  - Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.  Workload in Hours  - Credit points  - Examination Witten exam  Examination Mutation and scale  Assignment for the Following General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Mechanicals Engineering Compulsory General Engineering Sciences (German program): Specialisation Mechanical Engineering, Focus Mechanicals Compulsory General Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanicals Compulsory General Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Engineering Focus Post Product Development and Production Compulsory General Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanicals Sciences Compulsory General					
Personal Competence Social Competence Social Competence  **Students are able to discuss technical information in the fecture supported by activating methods.**  **Students are able to discuss technical information in the fecture supported by activating methods.**  **Students are able to independently deepen their acquired knowledge in exercises.**  **Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the fectures.**  **Workload in Hours**  **Workload in Hours**  **Workload in Hours**  **Workload in Hours**  **Examination duration and scale 120  **Assignment for the Following Courticuts*  **Assignment for the Following Courticuts*  **Carridit points**  *			etches,		
Students are able to discuss technical information in the lecture supported by activating methods.  Autonomy     Students are able to discuss technical information in the lecture supported by activating methods.      Students are able to independently deepen their acquired knowledge in exercises.     Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.  Workland in Hours     Independent Study Time \$8, Study Time in Lecture 112  Credit points     Examination     Witnes exam  Examination     Ourricula  Curricula  Curricula  Curricula  Ceneral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory     General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory     General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory     General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory     General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory     General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatonics: Compulsory     General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory     General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory     General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory     General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory		evaluate complex designs, technically.			
Students are able to discuss technical information in the lecture supported by activating methods.  **Students are able to independently deepen their acquired knowledge in exercises.**  **Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.  **Workload in Hours**  Independent Study Time 68, Study Time in Lecture 112  **Examination duration and scale**  Examination duration and scale**  **Students are Stephenering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical: Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanicios: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Mechanical Engineering, Focus Mechanical Engineering Science (Engile program): Specialisation Mechanical Engineering, Focus Brows Towns Tow	Personal Competence				
Students are able to independently deepen their acquired knowledge in exercises.     Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.  Workload in Hours  Independent Study Time 88, Study Time in Lecture 112  Credit points  Examination  Witten exam  Examination Written exam  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Broes Energy Systems: Compulsory  General Engineering Science (German program, 7 semester	Social Competence				
Sudonts are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of stectures.  Workload in Hours Independent Study Time 68, Study Time in Lecture 112  Credit points Examination Examination Examination  Examination  Examination  Examination  Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Secus Se		Students are able to discuss technical information in the lecture	re supported by activating methods.		
Sudonts are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of stectures.  Workload in Hours Independent Study Time 68, Study Time in Lecture 112  Credit points Examination Examination Examination  Examination  Examination  Examination  Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Secus Se	Autonomy				
Vertical in Hours	,	Students are able to independently deepen their acquired knowledge.	owledge in exercises.		
Workload in Hours  Credit points  Examination  Examination Muration and scale  Examination duration and scale  Assignment for the Following  Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanicals: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanicals: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanicals: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aterat Systems Engineering: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering,		Students are able to acquire additional knowledge and to	recapitulate poorly understood conte	ent e.g. by using the	video recordings of the
Examination duration and scale  Examination duration and scale  Examination duration and scale  Assignment for the Following General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Alterials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Meterials program; Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Meterials program; Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus M		lectures.			
Examination duration and scale  Examination duration and scale  Examination duration and scale  Assignment for the Following General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Alterials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Meterials program; Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Meterials program; Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus M	Workload in Hours	Independent Study Time 68. Study Time in Lecture 112			
Examination duration and scale  Assignment for the Following  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Metarials in Engineering Sciences: Compulsory  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Science (Germal Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Engineering Science  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Engry Systems: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering					
Examination duration and scale  Assignment for the Following Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems: Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus		Written exam			
Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Methatonics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Brows Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Brows Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisatio	Examination duration and scale				
Curricula  General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productio Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (English program): Speciali			hanical Engineering, Focus Energy S	vstems: Compulsory	
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation M					Compulsory
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin					
General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Speci					, ,
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering. Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Science Compulsory General					duction: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Alterials in Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer		General Engineering Science (German program): Specialisation Med	hanical Engineering, Focus Theoretic	al Mechanical Engine	eering: Compulsory
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mecha		General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineering, Foo	us Aircraft Systems E	ngineering: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production		General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineering	j, Focus Materials in	Engineering Sciences
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory		Compulsory			
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: 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 Mechatronics: 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 Mechatronics: Compulsory		General Engineering Science (German program, 7 semester): Specia	llisation Mechanical Engineering, Foo	us Mechatronics: Cor	npulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory  General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Com		General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering,	Focus Product Devel	opment and Production
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: 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		Compulsory			
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory		General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engineering,	Focus Theoretical N	Mechanical Engineering
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory		Compulsory			
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: 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): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory					Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory					
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production					
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory					ces: Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production					lustian Commit
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus 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 Materials in Engineering Science Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory					
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 Mechatronics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production  Compulsory			ecialisation Mechanical Engineering	, rocus Materials in	Engineering Sciences
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production Compulsory			Banklan Manhardton Fred	Maakataat	
Compulsory					
Constant Engineering Colonia (Engineering Program, 2 Contraction), Openianical Engineering, 19663 medianical Engineering			ecialisation Mechanical Engineering	Focus Theoretical M	Mechanical Engineering
	I	The state of the s		,oronoud N	



Compulsory

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

Course L0264: Advanced Mechanic	ral Engineering Design II
Тур	
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	• Crank drives
	Sliding bearings
	Elements of fluidics
	Lighten of hundres
	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 Tacchenhuch für den Macchinenhaus Greta K. H. Feldhusen, J./Hron V. Springer Verlag, eldstelle Auflage.
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente Rand I-III: Niemann, G. Springer-Verlag, aktuelle Auflage.</li> </ul>
	massimonomonia, sana i m, monami, an, opinigor vonag, anaono nanago.
	maconilor and robotal actions of the maconilors of the maconilor and the maconilors and t
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Konstruktionalakse Bahl, C., Deite W., Springer-Verlag, although Auffage.      Kons
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.      Machine and A. O. Schladt B. B. Barras Verlage also also also also also also also also
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      The Annual Control of the Control of th
	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	



Course L0262: Advanced Mechanic	al Engineering Design I
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Design Latin
	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
	• Lientents 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	
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>
	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
	Come monate destroit de appeticition monate

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	



Module M0708: Electrical E	ngineering III: Circuit Theory and Transients			
Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
<b>Professional Competence</b>				
Knowledge	Students are able to explain the basic methods for calculating el	lectrical circuits. They know the Fourie	er series analysis of li	near networks driven
	periodic signals. They know the methods for transient analysis or		ency domain, and they	are able to explain t
	frequency behaviour and the synthesis of passive two-terminal-circ	cuits.		
Skills	The students are able to calculate currents and voltages in linear	•		
	able to calculate transients in electrical circuits in time and frequen		espective transient be	haviour. They are able
	analyse and to synthesize the frequency behaviour of passive two-	terminal-circuits.		
Personal Competence	Out the state of t		Constant to the Control of the Control	
Social Competence	Students work on exercise tasks in small guided groups. They are e	encouraged to present and discuss thei	ir results within the gro	up.
Automomy	The students are ship to find out the grantined mathed to see this	ale a sirra a servativa a serbia a se		
Autonomy				
	lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gain knowledge to other courses like Electrical Engineering I and Mathematics I.			
	Kilowiedge to other courses like Electrical Engineering Fand Mathe	finalics i.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following	General Engineering Science (German program): Specialisation El	lectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program, 7 semester): Spec	-		npulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Ele			
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program, 7 semester): Spec			pulsory
	General Engineering Science (English program, 7 semester): Spec		oulsory	
	Computational Science and Engineering: Specialisation Engineeri	ing Sciences: Elective Compulsory		
	Mechatronics: Core qualification: Compulsory	ivo Compulare		
	Technomathematics: Specialisation III. Engineering Science: Electi	' '		
	Technomathematics: Specialisation III. Engineering Science: Electi	ive Compulsory		



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

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



Module M1320: Simulation	and Design of Mechatronic Systems			
Courses				
Title		Тур	Hrs/wk	CP
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2	2
Simulation and Design of Mechatronic Sys		Laboratory	1	2
Simulation and Design of Mechatronic Sys		Recitation Section (large)	1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and electrical engineering	g		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for design, m	odeling, simulation and optimization	of mechatronic systen	ns.
21.11				
Skills	Students are able to apply modern algorithms for modeling of model	echatronic systems. They can identi	ty, simulate and des	ign simple systems and
	implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups and pr	esent results to target groups.		
Autonomy	Students are able to recognize and improve knowledge deficits indep	pendently.		
	With instructor assistance, students are able to evaluate their own known	owledge level and define a further cou	urse of study.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Med	hanical Engineering, Focus Mechatro	nics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Med	hanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (German program): Specialisation Med	hanical Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program, 7 semester): Specia	ulisation Mechanical Engineering, Foo	cus Mechatronics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Specia	llisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compulsory
	General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engineering	Focus Theoretical N	Mechanical Engineering:
	Elective Compulsory			
	General Engineering Science (English program): Specialisation Med	nanical Engineering, Focus Aircraft Sy	ystems Engineering: 0	Compulsory
	General Engineering Science (English program): Specialisation Med			, ,
	General Engineering Science (English program): Specialisation Med			ering: Compulsory
	General Engineering Science (English program, 7 semester): Specia		-	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu			
	General Engineering Science (English program, 7 semester): Spe		•	
	Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems Engineering	g: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Compulsory	,		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engi	neering: Compulsory		
	Mechatronics: Core qualification: Compulsory	A 6		

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	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design	
	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab <sup>®</sup> and Simulink <sup>®</sup>	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	



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

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



Module M0777: Semicondu	ctor Circuit Design			
Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L0763)		Lecture	3	4
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence		-		
Knowledge				
	<ul> <li>Students are able to explain the functionality of different !</li> </ul>	MOS devices in electronic circuits.		
	Students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the fundamental digital logic circuits and of the students know the students	can discuss their advantages and disadva	ntages.	
	<ul> <li>Students have solid knowledge about memory circuits ar</li> </ul>	d can explain their functionality and speci	fications.	
	Students are able to explain how analog circuits function	s and where they are applied.		
	<ul> <li>Students know the appropriate fields for the use of bipola</li> </ul>	r transistors.		
Skills	Students can calculate the specifications of different MOS	devices and can define the parameters of	f electronic circuits.	
	Students are able to develop different logic circuits and c		. ologioni o gli oglici.	
	Students can use MOS devices, operational amplifiers are		ine	
	- Statemes can use inco devices, operational amplificio al	a bipolar transitions for specific application		
Personal Competence Social Competence	Students are able work efficiently in heterogeneous team     Students working together in small groups can solve prof			
Autonomy	Students are able to assess their level of knowledge.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foo	cus Mechatronics: Comp	oulsory
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory			
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foc	us Mechatronics: Comp	ulsory
Mechanical Engineering: Specialisation Mechatronics: Compulsory				
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		





Course L0864: Semiconductor Circ	uit Design
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	NN
Language	DE
Cycle	SoSe
Content	Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits  R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
	HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 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: Mathematic	es IV			
Courses				
		<b></b>	Here forts	0.0
Title Differential Equations 2 (Partial Differential	Equations /L1042)	Typ Lecture	Hrs/wk 2	CP
Differential Equations 2 (Partial Differential Differential Equations 2)		Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential		Recitation Section (Israel)	1	1
Complex Functions (L1038)	- Education (21010)	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 foll	owing learning results		
Professional Competence	The taking part suscessions, state in the reached the form	owing loaning rosalis		
Knowledge				
Knowleage	Students can name the basic concepts in Mathematic	cs IV. They are able to explain them using appro	priate examples.	
	Students can discuss logical connections between the students.	nese concepts. They are capable of illustrating the	hese connections w	ith the help of examples
	They know proof strategies and can reproduce them.			
Skills				
Skills	<ul> <li>Students can model problems in Mathematics IV with</li> </ul>	h the help of the concepts studied in this course	. Moreover, they are	capable of solving the
	by applying established methods.			
	Students are able to discover and verify further logical	al connections between the concepts studied in	the course.	
	For a given problem, the students can develop and e	execute a suitable approach, and are able to criti	cally evaluate the re	sults.
Paramal Commetance				
Personal Competence				
Social Competence	Students are able to work together in teams. They are	e capable to use mathematics as a common land	guage.	
	In doing so, they can communicate new concepts a			can design examples t
	check and deepen the understanding of their peers.	coording to the needs of their cooperating part	icio. Morcover, aley	can design examples
	check and deepen the understanding of their peers.			
Autonomy	Students are capable of checking their understanding	ng of compley concents on their own. They can	snecify onen gues	tions precisely and know
	where to get help in solving them.	ng or complex concepts on their cum mey car	. opcomy opc quoc	aono prodicory and inic
	Students have developed sufficient persistence to be	a able to work for langer periods in a goal erient	od mannar an hard	arablams
	Students have developed sufficient persistence to be	s able to work for longer periods in a goar-one in	ed marmer on nard p	Dioblems.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equations	s 2)		
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa		nics: Compulsorv	
	General Engineering Science (German program): Specialisa			eering: Compulsorv
	General Engineering Science (German program): Specialisa		ooamour Englit	g. compaisory
	General Engineering Science (German program, 7 semeste		lsony	
			•	mouleon
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 seme	sier). Specialisation viechanical Engineering,	i ocus ineoretical l	viecnanicai Engineerinį
	Compulsory	N. Consisting Novel April 1		
	General Engineering Science (German program, 7 semeste		ТУ	
	Computer Science: Specialisation Computational Mathemat	tics: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program): Specialisa	tion Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisa	tion Mechanical Engineering, Focus Mechatron	ics: Compulsory	
	General Engineering Science (English program): Specialisa	tion Mechanical Engineering, Focus Theoretica	l Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester	:): Specialisation Electrical Engineering: Compu	sory	
	General Engineering Science (English program, 7 semester	): Specialisation Mechanical Engineering, Focus	s Mechatronics: Cor	npulsory
	General Engineering Science (English program, 7 semes	, ,		
	Compulsory			<b>3</b>
	General Engineering Science (English program, 7 semester	:): Specialisation Naval Architecture: Compulsor	v	
	Computational Science and Engineering: Specialisation Engineering		,	
	, , , , , , , , , , , , , , , , , , , ,			
	Computational Science and Engineering: Specialisation Co			
	Mechanical Engineering: Specialisation Theoretical Mechan			
	Mechanical Engineering: Specialisation Mechatronics: Com	pulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complement			



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

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

Course 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



## **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.

	ng processes, to high-performance materials.  Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
	JI (1.0364)		2	2
Advanced Mechanical Engineering Design		Lecture  Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		· - ·	2	•
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	ı
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
·	After a section the second to the design of the second to			
Knowledge	After passing the module, students are able to:			
	explain complex working principles and functions of made.	chine elements and of basic elements of flui	dics.	
	explain requirements, selection criteria, application scer			
		ianos and practical examples of complex in	acimie elements,	
	<ul> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	After passing the module, students are able to:			
	<ul> <li>accomplish dimensioning calculations of covered machi</li> </ul>	ne elements,		
	<ul> <li>transfer knowledge learned in the module to new require</li> </ul>	ements and tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings and schema</li> </ul>	tic sketches,		
	evaluate complex designs, technically.			
Personal Competence				
Social Competence				
	Students are able to discuss technical information in the	lecture supported by activating methods.		
Autonomy				
Autonomy	Students are able to independently deepen their acquire	ed knowledge in exercises.		
	Students are able to acquire additional knowledge ar	ed to reconitulate poorly understood contr		
		id to recapitulate poorly understood conte	ent e.g. by using the	video recordings of th
		id to recapitulate poorly understood conte	ent e.g. by using the	video recordings of th
	lectures.	to recapitulate poorly understood conte	ent e.g. by using the	video recordings of th
Workload in Hours		to to recapitulate poonly understood conte	ent e.g. by using the	video recordings of th
Workload in Hours Credit points	lectures.	и и тесарпитате розпу индегатого сотте	ent e.g. by using the	video recordings of th
	lectures.  Independent Study Time 68, Study Time in Lecture 112	и to тесарпилате роопу understood come	ent e.g. by using the	video recordings of th
Credit points Examination	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam	и to тесарпилате роопу understood come	ent e.g. by using the	video recordings of th
Credit points Examination Examination duration and scale	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120			video recordings of th
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S	ystems: Compulsory	
Credit points Examination Examination duration and scale	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S	ystems: Compulsory ystems Engineering: (	Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials	ystems: Compulsory ystems Engineering: ( in Engineering Scien	Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory	Compulsory ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory	Compulsory ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Prod	Compulsory ces: Compulsory duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product E n Mechanical Engineering, Focus Theoretic	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product E n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems Er	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product E n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems Er	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	lectures.  Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product E n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, r): Specialisation Mechanical Engineering	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En In, Focus Materials in	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory Engineering Sciences
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product I n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc ry: Specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En g, Focus Materials in us Mechatronics: Con	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory Engineering Sciences
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester)	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product I n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc ry: Specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En g, Focus Materials in us Mechatronics: Con	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory Engineering Sciences
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc cry: Specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En g, Focus Materials in us Mechatronics: Con Focus Product Develo	Compulsory ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsory Engineering Science: npulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program): Specialisation General Engineering Sc	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc cry: Specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En g, Focus Materials in us Mechatronics: Con Focus Product Develo	Compulsory ces: Compulsory duction: Compulsory sering: Compulsory ngineering: Compulsory Engineering Sciences spulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc cry: Specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Prod al Mechanical Engine us Aircraft Systems En g, Focus Materials in us Mechatronics: Con Focus Product Develo	Compulsory ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsory Engineering Science npulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program): Specialisation General Engineering Sc	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, specialisation Mechanical Engineering, specialisation Mechanical Engineering,	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Develo	Compulsory ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester) Compulsory General Engineering Science (German program, 7 semester) Compulsory	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product I n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc c): Specialisation Mechanical Engineering, Foc e: Specialisation Mechanical Engineering, c): Specialisation Mechanical Engineering, c): Specialisation Mechanical Engineering,	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Con	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation 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) Compulsory General Engineering Science (German program, 7 semester) Compulsory General Engineering Science (German program, 7 semester) Compulsory General Engineering Science (German program, 7 semester)	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Specialisation Mechanical Engineering, specialisation Mechanical Engineering, specialisation Mechanical Engineering, Focus pecialisation Mechanical Engineering	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Con us Energy Systems: C	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation 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) Compulsory General Engineering Science (German program, 7 semester) Compulsory General Engineering Science (German program, 7 semester): S	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechatro n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Specialisation Mechanical Engineering, Specialisation Mechanical Engineering, Specialisation Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Energy Sy n Mechanical Engineering, Focus Energy Sy n Mechanical Engineering, Focus Energy Sy	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Con us Energy Systems: C ystems: Compulsory	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Science: npulsory opment and Production Mechanical Engineering mpulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Signeral Engineering Science (German program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Energy Sy specialisation Engineering, Focus Energy Sy specialisation Engineering, Focus Aircraft Sy	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Energy Sy specialisation Mechanical Engineering, Focus Materials	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Science: npulsory opment and Production Mechanical Engineering mpulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Materials specialisation Engineering, Focus Materials specialisation Engineering, Focus Materials specialisation Engineering, Focus Mechanical Engineering, Focus	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Devel  Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory ystems Engineering: C in Engineering Science nics: Compulsory	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory compulsory compulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical Engin	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Devel  Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory compulsory compulsory compulsory ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical Engin	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En in, Focus Materials in us Mechatronics: Con Focus Product Devel  Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory compulsory compulsory compulsory ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Energy Sy specialisation Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical Engineering, Fo	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod al Mechanical Engine	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory ces: Compulsory luction: Compulsory ering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Spec	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical special	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod al Mechanical Engine us Aircraft Systems En	Compulsory ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsory engineering Science npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory ees: Compulsory luction: Compulsory ering: Compulsory gineering: Compulsory gineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Signeral Engineering Science (English program): Specialisation General Engine	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical special	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod al Mechanical Engine us Aircraft Systems En	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory ces: Compulsory luction: Compulsory gineering: Compulsory gineering: Compulsory gineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Signeral Engineering Science (English program): Specialisation General Engine	In Mechanical Engineering, Focus Energy S In Mechanical Engineering, Focus Aircraft S In Mechanical Engineering, Focus Materials In Mechanical Engineering, Focus Mechanical In Mechanical Engineering, Focus Product D In Mechanical Engineering, Focus Theoretic In Mechanical Engineering, Focus Theoretic In Mechanical Engineering, Focus Indicated Engineering, Focus In Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus In Specialisation Mechanical Engineering, Focus Energy S In Mechanical Engineering, Focus Energy S In Mechanical Engineering, Focus Materials In Mechanical Engineering, Focus Theoretics In Mec	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En y, Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Coi us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Prod al Mechanical Engine us Aircraft Systems En y, Focus Materials in	Compulsory ces: Compulsory duction: Compulsory ering: Compulsory ngineering: Compulsory Engineering Science npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory ces: Compulsory ering: Compulsory gineering: Compulsory Engineering: Compulsory Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 68, Study Time in Lecture 112  6  Written exam  120  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Signeral Engineering Science (English program): Specialisation General Engine	n Mechanical Engineering, Focus Energy S n Mechanical Engineering, Focus Aircraft S n Mechanical Engineering, Focus Materials n Mechanical Engineering, Focus Mechanical n Mechanical Engineering, Focus Product D n Mechanical Engineering, Focus Theoretic specialisation Mechanical Engineering, Foc specialisation Mechanical Engineering, Focus Materials specialisation Mechanical Engineering, Focus Mechanical specialisation Mechanical Engineering, Focus Mechanical specialisation Mechanical Engineering, Focus Product D specialisation Mechanical Engineering, Focus	ystems: Compulsory ystems Engineering: C in Engineering Scien nics: Compulsory Development and Proc al Mechanical Engine us Aircraft Systems En procus Theoretical M us Biomechanics: Con ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems En procus Materials in us Mechatronics: Com us Energy Systems: C ystems: Compulsory rstems Engineering: C in Engineering Science nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems En procus Materials in	Compulsory ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsory Engineering Sciences npulsory opment and Production Mechanical Engineering mpulsory compulsory compulsory des: Compulsory luction: Compulsory ering: Compulsory gineering: Compulsory Engineering: Compulsory Engineering: Compulsory Engineering: Compulsory



Compulsory

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

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

Naval Architecture: Core qualification: Compulsory

Course L0264: Advanced Mechanic	al Engineering Design II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	Leatura
	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
	Bell & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
10.	
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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



Course L0262: Advanced Mechanic	al 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 Wise
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Design Latin
	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	
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>
	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



Modulo M0505, Advanced	Machanical Design Dysicat
Module M0596: Advanced	wechanical Design Project
Courses	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Project (L02	Practical Course 4 6
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
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,
	<ul> <li>explain guidelines for designing for function and manufacturing,</li> </ul>
	explain advanced use-oriented knowledge of machine elements.
Skilla	After passing the module, students are able to:
Skills	Arter passing the module, students are able to.
	analyze complex tasks and develop principle solutions using sketches,
	convert principle solutions into a detailed design,
	<ul> <li>use methods to design and solve engineering design tasks systematically and solution-oriented,</li> </ul>
	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,      add the arms as within the word arms of the arms.
	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 selecting appropriate methods,
	to independently solve problems.
	- to modpondonaly dolve production.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	180
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus 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



Course L0266: Advanced Mechanic	al Design Project
Тур	Practical Course
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff, 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
	<ul> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> </ul>
	<ul> <li>Erstellung einer ausführlichen Dokumentation</li> </ul>
	Lösungsfindung
	<ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> </ul>
	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.
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	<ul> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> </ul>
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen



Module M0726: Production	ı Technology			
Courses				
Fitle State of the		Тур	Hrs/wk	CP
Fundamentals of Machine Tools (L0689)		Lecture	3	3
Forming and Cutting Technology (L0613)		Lecture	2	2
Forming and Cutting Technology (L0614)		Recitation Section (large)	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 electric	al engineering		
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	Students are able to			
	a cyclein the begins of this formation and marketing	and models of moshiring		
	explain the basics of chip formation and mechanisms     explain methods and parameters for design and analysis.	•	and tools	
	<ul> <li>explain methods and parameters for design and anal</li> <li>explain technical concepts of machine tool building a</li> </ul>			
	explain technical concepts of machine tool building a     explain types, constructions and functions of CNC-ma			
	explain equipment components.	tormes and give an overview on mala mach	inic systems.	
	S. P. a			
Skills	Students are able to			
	<ul> <li>select tool geometry, cutting materials, process param</li> </ul>	neters and appropriate measuring technique	in accordance with the	requirements.
	estimate occurring forces and temperatures during ch	ip formation.		
	<ul> <li>select appropriate machine tools for machining and c</li> </ul>	reate NC programs for turning and milling.		
	assess the quality of a machine tools and to detect we	eak points.		
D				
Personal Competence	Students are able to			
Social Competence	Students are able to			
	develop solutions in a production environment with quality.	ualified personnel at technical level and rep	resent decisions.	
Autonomy	Students are able to			
	interpret independently cutting processes.			
	create independently NC programs.			
	select independently machine tools by reference to a	ppropriate requirements.		
	assess own strengths and weaknesses in general.			
	assess their learning progress and define gaps to be	improved.		
	assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Produc	ct Development and Pro	duction: Compulsory
Curricula	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineering	g, Focus Product Devel	opment and Product
	Compulsory			
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Produc	t Development and Proc	duction: Compulsory
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engineering	, Focus Product Devel	opment and Product
	Compulsory			
	Mechanical Engineering: Specialisation Product Developme	nt and Production: Compulsory		
	Product Development, Materials and Production: Technical C	Complementary Course Core Studies: Election	ve Compulsory	



Course L0689: Fundamentals of Machine Tools	
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
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	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006



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

Course L0614: Forming and Cutting	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	



Module M1009: Material Sci	ience Laboratory			
Courses				
Title		Тур	Hrs/wk	CP
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)	D (D   5   1	Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler none			
Admission Requirements  Recommended Previous	none			
Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following	Lograina roculto		
· · · · · · · · · · · · · · · · · · ·	After taking part successionly, students have reached the following	rearring results		
Professional Competence  Knowledge	Students are able to give a summary of the technical details of ex	poriments in the area of materials sais	noos and illustrato rooms	otivo rolationshins. They
Knowieage	are capable of describing and communicating relevant problem		·	
	process of solving practical problems and present related results.	is and questions using appropriate te	ciinicai language. They	can explain the typical
	process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on mate	rial sciences to the process of solving	practical problems. The	y identify and overcome
	typical problems during the realization of experiments in the conte	ext of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to condu	ct avacriments in the context of materi	ale ecianose Thay are a	hle to effectively present
30ciai Competence	and explain their results alone or in groups in front of a qualified a	•	als sciences. They are a	ble to ellectively present
	and explain from results alone of in groups in nont of a qualified of	adicinee.		
Autonomy	Students are capable of solving problems in the context of mate	rials sciences using provided literatur	re. They are able to fill g	aps in as well as extent
	their knowledge using the literature and other sources provided b	y the supervisor.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Colloquium			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson			
Assignment for the Following	General Engineering Science (German program): Specialisation I	Mechanical Engineering, Focus Materi	als in Engineering Scien	ces: Compulsory
Curricula	General Engineering Science (German program): Specialisation I	Mechanical Engineering, Focus Produ	ct Development and Prod	duction: Compulsory
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineer	ring, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Specialisation N	Mechanical Engineering, Focus Materia	als in Engineering Scienc	ces: Compulsory
	General Engineering Science (English program): Specialisation N	Mechanical Engineering, Focus Produc	ct Development and Prod	uction: Compulsory
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	Compulsory			
	Mechanical Engineering: Specialisation Product Development an			
	Mechanical Engineering: Specialisation Materials in Engineering			
	Product Development, Materials and Production: Technical Comp	lementary Course Core Studies: Elect	ive Compulsory	

Course L1088: Companion Lecture	·
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	WiSe
Content	Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are
	indicated in brackets for each experiment:
	1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)
	2. notch impact test (elastic properties of solids)
	3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)
	4. tensile test (elastic properties of solids)
	5. Identificiation of polymers (polymer physics)
	6. fiber-reinforced polymers (physical principles of composite materials)
	7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)
	8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)
Literature	William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007)



Course L1235: Material Science Laboratory	
Тур	Laboratory Course
Hrs/wk	4
CP	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	8 Versuche:
	Zustandsdiagramm, Wärmebehandlung, Härtemessung
	Kerbschlagbiegeversuch
	Vorgänge bei der Erstarrung von Metallen
	Zugversuch
	Identifizierung von Kunststoffen
	Faserverstärkte Kunststoffe
	Herstellung und Gefüge keramischer Werkstoffe
	Mechanisches Verhalten keramischer Werkstoffe
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II



Module M0599: Integrated I	Product Development and Lightweight Design	1		
Courses		_		
Title		Тур	Hrs/wk	CP
CAE-Team Project (L0271)	oto (L0270)	Problem-based Learning	2	2
Development of Lightweight Design Product Integrated Product Development I (L0269)		Lecture Lecture	2	2
Module Responsible	Prof. Dieter Krause	Ecoloro		
Admission Requirements	None			
7.4				
Recommended Previous	Advanced Knowledge about engineering design:			
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence	AG.			
Knowledge	After completing the module, students are capable of:			
	<ul> <li>explaining the functional principle of 3D-CAD-Systems</li> </ul>	, PDM- and FEM-Systems		
	<ul> <li>describing the interaction of the different CAE-Systems</li> </ul>	in the product development process		
Skills				
	After completing the module, students are able to:			
	and the different CAD and DDM Contains with remain			
	<ul> <li>evaluate different CAD- and PDM-Systems with regard</li> <li>design an exemplary product using CAD-,PDM- and/or</li> </ul>		ication schemes and	product structuring
	acaign an exemplary product using extern, and analysis	1 Em Oyotomo with onared workload		
Personal Competence				
Social Competence	After completing the module, students are able to:			
	<ul> <li>To develop a project plan and allocate work appropriat</li> </ul>	e work packages in the framework of group	discussions	
	Present project results as a team for instance in a present			
Ata. = = ===.	Chi.damha ara annahla afi			
Autonomy	Students are capable of:			
	independently adapt to a CAE-Tool and complete a given	ren practical task with it		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the Following	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Aircraft S	systems Engineering:	Compulsory
Curricula	General Engineering Science (German program): Specialisati	0 0,		, ,
	General Engineering Science (German program, 7 semester):	1	,	0 0 1 ,
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engineering,	Focus Product Devel	opment and Production:
	Compulsory  Conoral Engineering Science (English program): Specialisation	an Machanical Engineering Fears Aires &	votomo Enginocris -: (	Compulsory
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation		, ,	, ,
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester):	* *	•	
	General Engineering Science (English program, 7 semester).		•	
	Compulsory	,. 2,23 and a moonamour Engineering,	. 2200	
	Mechanical Engineering: Specialisation Product Developmen	and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems Engi	neering: Compulsory		
	Product Development, Materials and Production: Technical Co	emplementary Course Core Studies: Elective	Compulsory	



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

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

Course L0269: Integrated Product Development I		
Тур	Lecture	
Hrs/wk	2	
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	<ul> <li>Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag</li> <li>Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles</li> <li>Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag</li> <li>Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag</li> <li>Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag</li> </ul>	



## **Focus Theoretical Mechanical Engineering**

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

Courses				
Title		Тур	Hrs/wk	CP
Advanced Mechanical Engineering Desigr Advanced Mechanical Engineering Desigr		Lecture	2	2
Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design		Recitation Section (large) Lecture	2	1 2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence	, and the same of			
Knowledge	After passing the module, students are able to:			
ruiomoago	The passing the models, stateme are also to:			
	explain complex working principles and functions of	machine elements and of basic elements of fluid	dics,	
	explain requirements, selection criteria, application s		achine elements,	
	indicate the background of dimensioning calculation	5.		
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered ma			
	transfer knowledge learned in the module to new rec			
	recognize the content of technical drawings and sche	ematic sketches,		
	evaluate complex designs, technically.			
Personal Competence				
Social Competence				
	Students are able to discuss technical information in	the lecture supported by activating methods.		
Autonomy				
	Students are able to independently deepen their acq	uired knowledge in exercises.		
	Students are able to acquire additional knowledge	and to recapitulate poorly understood conte	nt e.g. by using the	video recordings of
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Workload in Hours Credit points	Independent Study Time 68, Study Time in Lecture 112			
Workload in Hours  Credit points  Examination	6			
Credit points Examination	6 Written exam			
Credit points Examination Examination duration and scale	6 Written exam 120	stion Mechanical Engineering Focus Energy S	ystems: Compulsory	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa			Compulsory
Credit points Examination Examination duration and scale	6 Written exam 120 General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa	ation Mechanical Engineering, Focus Aircraft Sy	stems Engineering: (	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialist General Engineering Science (German program): Specialist General Engineering Science (German program): Specialist	ation Mechanical Engineering, Focus Aircraft Sy ation Mechanical Engineering, Focus Materials	rstems Engineering: 0 in Engineering Scien	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa	ation Mechanical Engineering, Focus Aircraft Sy tition Mechanical Engineering, Focus Materials tition Mechanical Engineering, Focus Mechatron	rstems Engineering: ( in Engineering Scien nics: Compulsory	ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialis:	ation Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatro tion Mechanical Engineering, Focus Product D	rstems Engineering: 0 in Engineering Scien nics: Compulsory evelopment and Prod	ces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialist	ation Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials tion Mechanical Engineering, Focus Mechatror tion Mechanical Engineering, Focus Product D tion Mechanical Engineering, Focus Theoretica	stems Engineering: 0 in Engineering Scien nics: Compulsory evelopment and Prod al Mechanical Engine	ces: Compulsory duction: Compulsory pering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialiss: General Engineering Science (German program): Specialiss	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretica b): Specialisation Mechanical Engineering, Focus	rstems Engineering: C in Engineering Scien nics: Compulsory evelopment and Prod al Mechanical Engine us Aircraft Systems En	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120 General Engineering Science (German program): Specialist General Engineering Science (German program, 7 semeste	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretica b): Specialisation Mechanical Engineering, Focus	rstems Engineering: C in Engineering Scien nics: Compulsory evelopment and Prod al Mechanical Engine us Aircraft Systems En	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialiss: General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials tation Mechanical Engineering, Focus Mechatron tation Mechanical Engineering, Focus Product D tation Mechanical Engineering, Focus Theoretical '): Specialisation Mechanical Engineering, Focus ster): Specialisation Mechanical Engineering	rstems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er , Focus Materials in	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsi Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialiss: General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste Compulsory	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials tation Mechanical Engineering, Focus Mechatron tation Mechanical Engineering, Focus Product D tation Mechanical Engineering, Focus Theoretical c): Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus c): Specialisation Mechanical Engineering, Focus	rstems Engineering: C in Engineering Scien nics: Compulsory evelopment and Procal Mechanical Engine us Aircraft Systems Er , Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsi Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialiss: General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste Compulsory General Engineering Science (German program, 7 semeste	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials tation Mechanical Engineering, Focus Mechatron tation Mechanical Engineering, Focus Product D tation Mechanical Engineering, Focus Theoretical c): Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus c): Specialisation Mechanical Engineering, Focus	rstems Engineering: C in Engineering Scien nics: Compulsory evelopment and Procal Mechanical Engine us Aircraft Systems Er , Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsi Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialist General Engineering Science (German program, 7 semeste General Engineering Science (German program)	ation Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatror ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical by: Specialisation Mechanical Engineering, Focus ater): Specialisation Mechanical Engineering, Focus ater): Specialisation Mechanical Engineering, Focus ater): Specialisation Mechanical Engineering, Focus	rstems Engineering: Cin Engineering Scien in Engineering Scien incs: Compulsory evelopment and Procal Mechanical Engine is Aircraft Systems Er, Focus Materials in ins Mechatronics: Confocus Product Development	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialist General Engineering Science (German program, 7 semeste Compulsory	ation Mechanical Engineering, Focus Aircraft Sy tion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatror ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical (2): Specialisation Mechanical Engineering, Focus ater): Specialisation Mechanical Engineering, Focus (etr): Specialisation Mechanical Engineering, Focus (etr): Specialisation Mechanical Engineering, Focus (etr): Specialisation Mechanical Engineering, Focus (etr): Specialisation Mechanical Engineering, Focus	rstems Engineering: (in Engineering Scien in Engine	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste Compulsory General Engineering Science (German program, 7 semeste Compulsory General Engineering Science (German program, 7 semeste Compulsory	ation Mechanical Engineering, Focus Aircraft Sy tation Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatror ation Mechanical Engineering, Focus Product D tation Mechanical Engineering, Focus Theoretical (2): Specialisation Mechanical Engineering, Focus (3): Specialisation Mechanical Engineering, Focus (4): Specialisation Mechanical Engineering, Focus (5): Specialisation Mechanical Engineering, Focus (5): Specialisation Mechanical Engineering, Focus (6): Specialisation Mechanical Engineering, Focus (7): Specialisation Mechanical Engineering, Focus (7): Specialisation Mechanical Engineering, Focus	rstems Engineering: (in Engineering Scien in Engineering Scien in Engineering Scien in Engineering Scien in Engineering Mechanical Engineers Aircraft Systems Engineers Materials in us Mechatronics: Confocus Product Development Theoretical Mechanics: Cousting Theoretical Mechanics: Cous	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste Compulsory General Engineering Science (German program, 7 semeste General Engineering Science (German program)	ation Mechanical Engineering, Focus Aircraft System Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product Dation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Focialisation Mechanical Engineering, Focus Focialisation Mechanical Engineering, Focus Focialisation Mechanical Engineering, Focialisation Mechanic	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Cou us Energy Systems: Cou se En	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste Compulsory  General Engineering Science (German program, 7 semeste General Engineering Science (German program): Specialisa	ation Mechanical Engineering, Focus Aircraft System Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product Dation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Engineering, Focus Engineering, Focus Engineering, Focus Energy System Mechanical Engineering	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er Focus Materials in us Mechatronics: Con Focus Product Devel Focus Theoretical M us Biomechanics: Con us Energy Systems: Cos stems: Compulsory	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (German program): Specialisa General Engineering Science (English program): Specialisa General Engineering Science (English program): Specialisa	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product Dation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Aircraft Systio	rstems Engineering: Cin Engineering: Cin Engineering Scien nics: Compulsory evelopment and Procal Mechanical Engine as Aircraft Systems Er, Focus Materials in us Mechatronics: Confocus Product Development and Procus Theoretical Mechatronics: Cous Energy Systems: Costems: Compulsory stems Engineering: Cin Engine	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (German program): Specialisa General Engineering Science (English program): Specialisa General Engineering Science (English program): Specialisa General Engineering Science (English program): Specialisa	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in Mecha	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er Focus Materials in us Mechatronics: Con focus Product Devel us Biomechanics: Cou us Energy Systems: Co stems: Compulsory stems Engineering: Con n Engineering Science	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (German program): Specialisa General Engineering Science (English program): Specialisa General Engineering Science (Eng	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Mechanical Engineering	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er Focus Materials in us Mechatronics: Con focus Product Devel us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science nics: Compulsory	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory displayed and Product dechanical Engineer
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (Engl	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Product Dept.	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er Focus Materials in us Mechatronics: Con Focus Product Devel us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Prod	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (Engl	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials is the Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Diction Mechanical Engineering, Focus Theoretical Engineeri	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems En r, Focus Materials in us Mechatronics: Con Focus Product Devel us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science nics: Compulsory evelopment and Prod al Mechanical Engine	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (Engl	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoreticals: Specialisation Mechanical Engineering	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er , Focus Materials in us Mechatronics: Con Focus Product Develo us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Proc al Mechanical Engine s Aircraft Systems En	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (E	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoreticals: Specialisation Mechanical Engineering	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er , Focus Materials in us Mechatronics: Con Focus Product Develo us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Proc al Mechanical Engine s Aircraft Systems En	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (E	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Materials ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in tion Mechanical Engineering, Focus Materials in tion Mechanical Engineering, Focus Mechatron tion Mechanical Engineering, Focus Product Detion Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Specialisation Mechanical Engineering, Focus Ster):	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er , Focus Materials in us Mechatronics: Con Focus Product Develo us Biomechanics: Con us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Prod al Mechanical Engine s Aircraft Systems En , Focus Materials in	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (English program, 7 semester General Engineering Science (English program	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Determine Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineerin	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems En rs Focus Materials in us Mechatronics: Con Focus Theoretical M us Biomechanics: Cou us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Proc ul Mechanical Engine s Aircraft Systems En Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsory ngineering: Compulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory des: Compulsory ering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisa General Engineering Science (German program, 7 semeste General Engineering Science (English program): Specialisa General Engineering Science (E	ation Mechanical Engineering, Focus Aircraft Systion Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Mechatron ation Mechanical Engineering, Focus Product D ation Mechanical Engineering, Focus Theoretical Engineering, Focus Specialisation Mechanical Engineering, Focus Eter): Specialisation Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Energy Systion Mechanical Engineering, Focus Materials in the Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Determine Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineerin	rstems Engineering: Cin Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems En rs Focus Materials in us Mechatronics: Con Focus Theoretical M us Biomechanics: Cou us Energy Systems: Co stems: Compulsory stems Engineering: Co n Engineering Science ics: Compulsory evelopment and Proc ul Mechanical Engine s Aircraft Systems En Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsory ngineering: Compulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory des: Compulsory ering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory igineering: Compulsory



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

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

 $Naval\ Architecture: Core\ qual\underline{ification:}\ \underline{Compulsory}$ 

Course L0264: Advanced Mechanic	al 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
Content	Advanced mechanical Engineering Design 1 & 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	
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> </ul>
	<ul> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> </ul>
	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	



Course L0262: Advanced Mechanic	al Engineering Design I
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe WiSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced mechanical Engineering Design 1 & 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	
	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> </ul>
	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
	Downe werene provinci za speziarieri i Heriteri

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



Module M0684: Heat Transf	ior			
Wodule Wood. Heat Halls	lei			
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an approa	ch.		
Autonomy	The students are able to develop a complex problem self-consistent and	d analyse the results in a critical w	av. A qualified exchang	ne with other students is
	given.		-,	,
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Mecha			
Curricula	General Engineering Science (German program): Specialisation Mecha		Systems: Compulsory	
	General Engineering Science (German program): Specialisation Biomed			
	General Engineering Science (German program): Specialisation Mecha			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specia	ansarion Mechanical Engineering	, Focus Theoretical IV	echanicai Engineering:
	Compulsory  General Engineering Science (German program, 7 competer): Specialise	ation Biomodical Engineering: Co.	mouleony	
	General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Specialisation Biomed		iipulsury	
	General Engineering Science (English program): Specialisation Biomed		anics: Compulsory	
	General Engineering Science (English program): Specialisation Mechan			
	General Engineering Science (English program): Specialisation Mechan	0 0,	, ,	ering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisa			
	General Engineering Science (English program, 7 semester): Specia			
	Compulsory	- 0		5 0
	General Engineering Science (English program, 7 semester): Specialisa	tion Biomedical Engineering: Con	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulsory			
	Mechanical Engineering: Specialisation Theoretical Mechanical Engine	ering: 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, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z. Springer- Verlag, Berlin, Heidelberg, 2000
	- Herwig, H.: Warmer und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



Module M1320: Simulation	and Design of Mechatronic Systems			
Courses				
Title		Тур	Hrs/wk	CP
Simulation and Design of Mechatronic Syst		Lecture	2	2
Simulation and Design of Mechatronic Syst		Laboratory	1	2
Simulation and Design of Mechatronic Syst		Recitation Section (large)	1	2
Module Responsible				
· ·	None			
Recommended Previous	Fundatmentals of mechanics, control theory and electrical engineer	ng		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning to the students have reached the students hav	earning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for design,	modeling, simulation and optimization	of mechatronic systen	ns.
Chille	Children are alle to analy modern alreadings for modeling of			::
Skills	Students are able to apply modern algorithms for modeling of n	lechaironic systems. They can identi	ny, simulate and des	ign simple systems and
	implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups and p	present results to target groups.		
Autonomy	Students are able to recognize and improve knowledge deficits inde	pendently.		
	With instructor assistance, students are able to evaluate their own ke	nowledge level and define a further cou	urse of study.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Mechatro	onics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Aircraft S	Systems Engineering:	Compulsory
	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program, 7 semester): Spec	alisation Mechanical Engineering, Foo	cus Mechatronics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Spec	alisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compulsory
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	, Focus Theoretical M	Mechanical Engineering:
	Elective Compulsory			
	General Engineering Science (English program): Specialisation Me	chanical Engineering, Focus Aircraft S	ystems Engineering: (	Compulsory
	General Engineering Science (English program): Specialisation Me	chanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program): Specialisation Me	chanical Engineering, Focus Theoretic	al Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester): Speci	alisation Mechanical Engineering, Foc	us Mechatronics: Con	npulsory
	General Engineering Science (English program, 7 semester): Speci	alisation Mechanical Engineering, Foc	us Aircraft Systems Er	ngineering: Compulsory
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering	, Focus Theoretical M	Mechanical Engineering:
	Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems Engineering	g: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Compulsory	•		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering	gineering: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	weenanomes. Our quanneanom. Compuisory			

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	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design	
	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab <sup>®</sup> and Simulink <sup>®</sup>	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	



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

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



Madula M0505, Advanced	Machanical Design Dysicat
Module M0596: Advanced	Medianical Design Project
Courses	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Project (L02	Practical Course 4 6
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
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,
	<ul> <li>explain guidelines for designing for function and manufacturing,</li> </ul>
	explain advanced use-oriented knowledge of machine elements.
Skilla	After passing the module, students are able to:
Skills	Arter passing the module, students are able to.
	analyze complex tasks and develop principle solutions using sketches,
	convert principle solutions into a detailed design,
	<ul> <li>use methods to design and solve engineering design tasks systematically and solution-oriented,</li> </ul>
	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,      add the arms as within the word arms of the arms.
	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 selecting appropriate methods,
	to independently solve problems.
	- to modpondonaly dolve production.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	180
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus 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



Course L0266: Advanced Mechanical Design Project		
Тур	Practical Course	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff, 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	
	<ul> <li>Erstellung einer ausführlichen Dokumentation</li> </ul>	
	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	



Module M0854: Mathematic	es IV			
Courses				
Title		Тур	Hrs/wk	CP
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential		Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential	Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge				
	<ul> <li>Students can name the basic concepts in Mathem</li> </ul>	atics IV. They are able to explain them using appro	priate examples.	
	<ul> <li>Students can discuss logical connections between</li> </ul>	these concepts. They are capable of illustrating t	hese connections w	ith the help of examp
	<ul> <li>They know proof strategies and can reproduce the</li> </ul>	em.		
Skills				
	Students can model problems in Mathematics IV v	with the help of the concepts studied in this course	. Moreover, they are	e capable of solving t
	by applying established methods.			
	<ul> <li>Students are able to discover and verify further log</li> </ul>	jical connections between the concepts studied in	the course.	
	<ul> <li>For a given problem, the students can develop and</li> </ul>	d execute a suitable approach, and are able to criti	cally evaluate the re	esults.
Personal Competence				
Social Competence				
	<ul> <li>Students are able to work together in teams. They</li> </ul>	are capable to use mathematics as a common lan	guage.	
	<ul> <li>In doing so, they can communicate new concepts</li> </ul>	according to the needs of their cooperating partr	ers. Moreover, they	can design example
	check and deepen the understanding of their peer	rs.		
Autonomy				
Adonomy	<ul> <li>Students are capable of checking their understand</li> </ul>	ding of complex concepts on their own. They car	specify open ques	tions precisely and k
	where to get help in solving them.			
	<ul> <li>Students have developed sufficient persistence to</li> </ul>	be able to work for longer periods in a goal-oriente	ed manner on hard	problems.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
	Written exam			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equation			
Assignment for the Following	General Engineering Science (German program): Specia			
Curricula	General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Mechatror	nics: Compulsory	
	General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Theoretica	al Mechanical Engin	eering: Compulsory
	General Engineering Science (German program): Specia	lisation Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semes	ster): Specialisation Electrical Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semes	ster): Specialisation Mechanical Engineering, Focu	s Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Enginee
	Compulsory			
	General Engineering Science (German program, 7 semes	ster): Specialisation Naval Architecture: Compulsor	y	
	Computer Science: Specialisation Computational Mathen	natics: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Special	isation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special		ics: Compulsory	
	General Engineering Science (English program): Special			eering: Compulsory
	General Engineering Science (English program, 7 semes			
				mouleon
	General Engineering Science (English program, 7 semes	, ,		
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engineering,	rocus Ineoretical	wecnanical Enginee
	Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Naval Architecture: Compulsor	у	
	Computational Science and Engineering: Specialisation I	Engineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisation (	Computer Science: Elective Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mech	nanical Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Co	ompulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complem	pentary Course Core Studies: Flective 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	
	<ul> <li>Examples of partial differential equations</li> <li>First order quasilinear differential equations</li> <li>Normal forms of second order differential equations</li> <li>Harmonic functions and maximum principle</li> <li>Maximum principle for the heat equation</li> <li>Wave equation</li> <li>Liouville's formula</li> <li>Special functions</li> <li>Difference methods</li> <li>Finite elements</li> </ul>	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1044: Differential Equations 2 (Partial Differential Equations)		
•	Out 36 E 1044. Differential Equations 2 () at that Differential Equations)	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Course L1038: Complex 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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



## **Specialization Process Engineering**

Module M0886: Fundament	als of Process Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Introduction into Process Engineering/Biop		Lecture	2	1
Fundamentals of material engineering (L08		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 fol	lowing learning results		
Professional Competence				
Knowledge	After passing this module the students have the ability to:			
	<ul> <li>give an overview of the most important fields on pro-</li> </ul>	cess and bioprocess engineering.		
	explain some working methods for different fields in			
		F		
Skills	After passing this module the students should have the abil	ity to:		
	<ul> <li>list and outline the most important fields of process expenses.</li> </ul>	engineering		
	name the most important working approaches or me		aineerina	
	<ul> <li>read and prepare an engineering drawing,</li> </ul>	and of the american noise of process on	gg,	
	<ul> <li>explain the most important technologies for wastewa</li> </ul>	ater and exhaust air treatment		
	scheme typical chemical and biotechnological process.		ers.	
		,		
Personal Competence				
Social Competence	The students are able to			
	<ul> <li>work out results in groups and document them,</li> </ul>			
	<ul> <li>provide appropriate feedback and handle feedback</li> </ul>	on their own performance constructively		
	- provide appropriate recubación and nariale recubación	on their own performance constitutively.		
Autonomy	The students are able to estimate their progress of learn	ing by themselves and to deliberate th	eir lack of knowledge in Pro	ocess Engineering and
	Bioprocess Engineering.			
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
Examination				
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialis	ation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialis		orv	
556010	General Engineering Science (German program, 7 semeste		•	
	General Engineering Science (German program, 7 semeste			
	Bioprocess Engineering: Core qualification: Compulsory	Specialisation Dioprocess Engineerin	.g. compaisory	
	General Engineering Science (English program): Specialisa	ation Bioprocess Engineering: Compulso	irv	
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist	, , , , , , , , , , , , , , , , , , , ,	'' y	
			Compulsory	
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	i). Specialisation bioprocess Engineering	g. Compuisory	
	Process Engineering: Core qualification: Compulsory			

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



Course L0830: Fundamentals of ma	aterial 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	<ul> <li>Introduction</li> <li>Atomic structure and bonding</li> <li>Structure of solids</li> <li>Miller indices</li> <li>Imperfections in solids</li> <li>Texture</li> <li>Diffusion</li> <li>Mechanical properties</li> <li>Dislocations and strengthening mechanisms</li> <li>Phase transformations</li> <li>Phase diagrams, iron-carbon phase diagram</li> <li>Metallic materials</li> <li>Corrosion</li> <li>Polymeric materials</li> <li>Ceramic materials</li> </ul>
Literature	<ul> <li>Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012.</li> <li>Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009.</li> <li>Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008.</li> <li>Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013.</li> <li>Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.</li> </ul>



Module M0937: Physical Cl	nemistry			
Courses		T	Here to de	0.0
Title Physical Chemistry (L0833)		Typ	Hrs/wk	<b>CP</b> 2
Physical Chemistry (L0835)  Physical Chemistry (L0835)		Lecture Laboratory Course	2	1
Module Responsible	Prof. Hans-Ulrich Moritz	,		
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemistry, physics for en	gineers and mathematics I-III.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-, heat-	and momentum transfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.			
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.  - assess new applications with respect to environmental sustainability.			
	- abstract their knowldege to related issues to conduct thermodynamic	cal, electrochemical and kinetic ca	lculations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document experiments according to scientific guidelines in small groups.			
	The students are able to reflect their subject-specific knowledge orall	y in a team and to discuss it with fe	llow students and faculty	
Autonomy	Students are able to assess their knowldege continuously on their o	wn by exemplified practice. Studer	nts are able to apply their	knowldege discretely to
,	plan, prepare and conduct experiments.		,,,,	,
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Pro	cess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bio	process Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	alisation Bioprocess Engineering: I	Elective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation Program			
	General Engineering Science (English program): Specialisation Biop			
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia	iisaiion Bioprocess Engineering: E	elective Compulsory	
	Process Engineering: Core qualification: Compulsory			

Course L0833: Physical Chemistry	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of
	chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces
Literature	P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013
	P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008
	G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012
	R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993
	U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011



Course L0835: Physical Chemistry	
Тур	Laboratory Course
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
	Reaction kinetics
	Freezing-point depression (cryoscopy)
	Electrical mobility of ions
	Viscosimetry
	Heat of neutralization
	Surface tension
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Module M0536: Fundament	als of Fluid Mechanics				
Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Fluid Mechanics (L0091)		Lecture	2	4	
Fluid Mechanics for Process Engineering	(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 differential equations	ations			
	<ul><li>Integration</li></ul>				
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results			
Professional Competence	,,				
Knowledge	Students are able to:				
	<ul> <li>explain the difference between different types of flo</li> <li>give an overview for different applications of the Re</li> </ul>		ring		
	explain simplifications of the Continuity- and Navie				
		=,g p.,,, -			
Skills	The students are able to				
	describe and model incompressible flows mathematically				
	reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration				
	notice the dependency between theory and technical applications				
	<ul> <li>use the learned basics for fluid dynamical applicati</li> </ul>	ons in fields of process engineering			
Personal Competence					
Social Competence	The students				
	<ul> <li>are capable to gather information from subject rela</li> </ul>	tod professional publications and relate that inf	armatian to the contain	t of the leature and	
	<ul> <li>able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)</li> </ul>				
	are able to work out solutions for exercises by them	nselves, to discuss the solutions orally and to pro	esent the results.		
A. t	The objects are able to				
Autonomy	The students are able to				
	search further literature for each topic and to expan	nd their knowledge with this literature,			
	work on their exercises by their own and to evaluate	e their actual knowledge with the feedback.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and scale	3 hours				
Assignment for the Following	General Engineering Science (German program): Speciali	sation Process Engineering: Compulsory			
Curricula	General Engineering Science (German program): Speciali	sation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program): Speciali	sation Energy and Enviromental Engineering: C	Compulsory		
	General Engineering Science (German program, 7 semes		•		
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory				
	General Engineering Science (German program, 7 semes: Bioprocess Engineering: Core qualification: Compulsory	டிர். அசப்பெக்காள் Energy and Enviromental Er	igineering: Compulso	y	
	Energy and Environmental Engineering: Core qualification	n: Compulsory			
	General Engineering Science (English program): Specialis	• •			
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program): Specialis	sation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semestr	er): Specialisation Process Engineering: Compu	ulsory		
	General Engineering Science (English program, 7 semest				
	General Engineering Science (English program, 7 semest	, ,	gineering: Compulsor	у	
	Technomathematics: Specialisation III. Engineering Science	ce: Elective Compulsory			
	Process Engineering: Core qualification: Compulsory				



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

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



Module M0544: Phase Equ	ilibria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	CP
Thermodynamics III (L0114)		Lecture	2	2
Thermodynamics III (L0140)		Recitation Section (small)	1	2
Thermodynamics III (L0142)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
	None			
Admission Requirements				
Recommended Previous	Mathematics, Physical Chemistry, Thermodynamics I a	nd II		
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
	Starting from the very basics of thermodynamics			
		y the mixing of compounds and learn concepts to		
		oria can be described mathematically and which p		if different phases (vapo
		the fundamentals of reaction equilibria are taugh		
	For different phase equilibria, several examples	s relevant for different kinds of processes are show	vn and the necessary k	nowledge for plotting an
	interpreting the equilibria are taught.			
Skills				
	Applying their knowledge, the students are ab	le to identify the correct equation for the determine	nation of the equilibriur	n state and know how t
	simplify these equations meaningfully.			
	The students know models which can be used	to determine the properties of the system in the	equilibrium state and t	hey are able to solve the
	resulting mathematical relations.			
	For specific applications, they are able to self-re	eliantly find necessary physico-chemical propertie	s of compounds as we	I as model parameters i
	literature sources.			
	Beside pure compound properties the students	are capable of describing the properties of mixtur	es.	
	The students know how to visualize phase equi	libria graphically and they know how to interpret t	he occurring phenomer	ia.
		able to understand fundamental concepts that a		
	processes in chemical engineering.		,	
	pgg			
B				
Personal Competence				
Social Competence	The students are able to work in small groups, to solve	the corresponding problems and to present them	oraly to the tutors and o	ther students
Autonomy	The students are able to find necessary informs	tion calf-religantly in literature courses and to judge	their quality	
	The students are able to find necessary informa     During the competer the students are able to obtain			wlodgo the students
		neck their learning progress continuously in exerc	ases. Daseu on this kno	wieuge the students ca
	adept their learning process.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Spec	cialisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Spec	0 0 1 ,		
Garricula	General Engineering Science (German program, 7 sen		nulsory	
	General Engineering Science (German program, 7 sen	, .	ompuisory	
	Bioprocess Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Spec			
	General Engineering Science (English program): Spec			
	General Engineering Science (English program, 7 sem	ester): Specialisation Process Engineering: Comp	oulsory	
	General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	, ,	•	



Course L0114: Thermodynamics III			
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			
	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure		
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>		

Course L0140: Thermodynamics III				
Тур	Recitation Section (small)			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Irina Smirnova			
Language	DE			
Cycle	SoSe			
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure  The students work on tasks in small groups and present their results in front of all students.			
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>			



Course L0142: Thermodynamics III			
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	?		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	SoSe		
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure		
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>		



ourses	
tle	Typ Hrs/wk CP
	Typ Hrs/wk CP  Lecture 3 4
gnals and Systems (L0432) gnals and Systems (L0433)	Recitation Section (large) 1 2
Module Responsible	Prof. Gerhard Bauch
Admission Requirements	None None
Recommended Previous	Mathematics 1-3
Knowledge	manoritation 1 o
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathematik 1-3 is exp Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are
	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic s
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which
	caused by the transition of a continuous-time signal to a discrete-time signal.
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can a
	the impact of LTI systems on the signal properties in time and frequency domain.
Personal Competence	
Social Competence	The students can jointly solve specific problems.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the let
·	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Computer Systems Engineering (Computer Systems Engineering) (Computer Systems Engine
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



Courses				
Title		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (L0841)		Lecture	2	3
Bioprocess Engineering- Fundamentals (L		Recitation Section (large)	2	1
Bioprocess Engineering - Fundamental Pr		Laboratory Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	none			
Recommended Previous	none, module "organic chemistry", module "fundamentals for p	rocess engineering"		
Knowledge	After the Community of the state that the state that the fall of	to a la conta con a colle		
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence Knowledge				
Skills	After successful completion of this module, students should be able to  describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters  predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process  analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations  distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them 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 Autonomy	After completion of this module participants should be able to own opinions and increase their capacity for teamwork in engine After completion of this module participants will be able to spresent their results in a plenum.	neering and scientific environments.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	nn Process Engineering: Compulsory		
Curricula				
	General Engineering Science (German program, 7 semester):		Ilsory	
	General Engineering Science (German program, 7 semester):		-	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisatio	n Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): S	Specialisation Bioprocess Engineering: Com	pulsory	
	Biomedical Engineering: Specialisation Artificial Organs and R			
	Biomedical Engineering: Specialisation Implants and Endopro	stheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology a	nd Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Bus	iness Administration: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Science: E	lective Compulsory		
	Process Engineering: Core qualification: Compulsory			



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

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

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



Module M0891: Informatics	for Process Engineers			
Courses				
Title		Тур	Hrs/wk	СР
Informatics for Process Engineers (L0836		Lecture	2	2
Informatics for Process Engineers (L0837		Recitation Section (small)	2	2
Numeric and Matlab (L0125)		Laboratory Course	2	2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements	None.			
Recommended Previous	Basic knowledge in using MS Windows.			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students can describe procedural and object-oriented concep	ts.		
Skills	Students are capable of object-oriented programming in the pr	rograming language, lava and of solving ma	athematic questions b	v using Matlah
S.i.iii	oragina are capable or object one near programming in the pr	og.ag language out and or coming me		y doing madab.
	Students are capable of developing concepts (simple algorithm	ns) to solve technical questions.		
Personal Competence				
Social Competence	Students are able to work out solutions together in small groups.			
Coolai Competence	Cladente are able to work out solutions together in small group			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Process Engineering: Elective Compulso	ory	
Curricula	General Engineering Science (German program, 7 semester):			ompulsory
	General Engineering Science (German program, 7 semester):			
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisation	on Process Engineering: Elective Compulso	ry	
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Enviromental En	gineering: Elective Co	ompulsory
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Electiv	e Compulsory	
	Process Engineering: Core qualification: Compulsory			



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

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



Course L0125: Numeric and Matlab	
Тур	Laboratory 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	1. Programming in Matlab 2. Numerical methods for systems of nonlinear equations 3. Basics in computer arithmetic 4. Linear and nonlinear optimization 5. Condition of problems and algorithms 6. Verified numerical results with INTLAB
Literature	Literatur (Software-Teil):  1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004  2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007  3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de  4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005



Module M1274: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	CP
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt	(1.11)		
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge	Tundanonalo ormolganio organio orionioa y ana oriology			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
	The landing part successionly, stadents have readined the following	ng rearning results		
Professional Competence	NAViata alang pengelakian ang alain ang aluing alang akundanaka naguring in alang	th language of improved a compared of the comp		
Knowledge	With the completion of this module the students acquire in-dept	• •	•	·
	might occur from production processes, projects or construction			
	in dealing with different methods and instruments to assess en		is are able to estimate	the complexity of thes
01.71	environmental processes as well as uncertainties and difficultie		and the state of the same of the state of th	
Skills	'			
	solutions for managing and mitigating environmental problem			
	independently and can apply the software programs OpenLCA		g the course the stude	its nave the competent
	to critically judge research results or other publications on envir	onnental impacts.		
Personal Competence				
Social Competence	The students are able to discuss the various technical and sci	entific tasks, both subject-specific and mu	ıltidisciplinary. They ar	e able to develop join
	different solutions and to discuss their theoretical or practical i			
	multi-layered issues of the environment protection and the co			
	raised and which helps to raise their awareness of their future s			
	·			
Autonomy	The students learn to research, process and present a scientif	ic topic independently. They are able to c	arry out independent	scientific work. They ca
ŕ	solve an environmental problem in a business context and are		,	,
	·			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Energy and Enviromental Engineering: (	Compulsory	
Curricula	General Engineering Science (German program): Specialisatio			
Jannoula	General Engineering Science (German program, 7 semester): S			v
	General Engineering Science (German program, 7 semester): S			,
	General Engineering Science (German program, 7 semester): S			
	Bioprocess Engineering: Core qualification: Elective Compulso			
	Energy and Environmental Engineering: Core qualification: Cor			
	General Engineering Science (English program): Specialisation		Compulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): S		•	,
	General Engineering Science (English program, 7 semester): S			
	General Engineering Science (English program, 7 semester): S			
	Process Engineering: Core qualification: Elective Compulsory		Jonnpaloo.y	
	Process Engineering: Core qualification: Compulsory			
	1 100000 Engineering. Oure qualification. Compulsory			



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

Course L1054: Environmental 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	
Language	DE	
Cycle	SoSe	
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better.	
	Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	Power point Präsentationen	



Module M0538: Heat and M	lass Transfer			
0				
Courses		Tun	Hrs/wk	CP
Heat and Mass Transfer (L0101)		Typ Lecture	2 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				
Knowledge	The students are capable of explaining qualitative and d chemical reactors). They are capable of distinguish and characterize different radiation. The students have the ability to explain the physical basis using suitable mass transfer theories. They are able to depict the analogy between heat- and mass	kinds of heat transfer mechanisms name for mass transfer in detail and to describe	e mass transfer quali	neat transfer and therma
Skills	<ul> <li>The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance to corresponding energy and mass flow, respectively.</li> <li>They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate to corresponding heat flows.</li> <li>Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.</li> <li>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).</li> <li>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.</li> <li>In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.</li> <li>The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the course thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.</li> </ul>		ids) and to calculate the ledge for the description or a specific application	
Personal Competence Social Competence				
Autonomy	<ul> <li>The students are able to find and evaluate necessary information from suitable sources</li> <li>They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation P			
Curricula	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe		•	
	General Engineering Science (German program, 7 semester): Spe			У
	Bioprocess Engineering: Core qualification: Compulsory			•
	Energy and Environmental Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): Specialisation Bi	oprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Engineering	nergy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (English program): Specialisation Pr			
	General Engineering Science (English program, 7 semester): Spec		-	
	General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec			ı,
	Technomathematics: Specialisation III. Engineering Science: Elect		meening. Compuisor	y
	Technomathematics: Core qualification: Elective Compulsory			
	Process Engineering: Core qualification: 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	1. 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 Mass Trans	Course L1868: Heat and Mass Transfer	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	CP
Thermal Separation Processes (L0118)		Lecture	2	2
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students can distinguish and describe different types of the students develop an understanding for the course of process, the possibilities of energy saving, and the selection. They have good knowledge of designing methods for separate	concentration during a separation proc on of separation systems		
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associated energy and material balances</li> <li>The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required</li> <li>They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables)</li> <li>They can calculate continuous and discontinuous processes</li> <li>The students are able to prove their theoretical knowledge in the experimental lab work.</li> <li>The students are able to discuss the theoretical background and the content of the experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems Other lectures such as thermodynamics, fluid mechanics and chemical engineering.</li> </ul>			
Personal Competence Social Competence	The students can work technical assignments in small grounds.	ups and present the combined results in	the tutorial	
Autonomy	The students are able to carry out practical lab work in some discuss their results and to document them scientifically in  The students are capable to obtain the needed information  The students can proof the state of their knowledge with expected to the state of their knowledge.	a report.	nd assess their quality	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination				
Examination duration and scale	120 minutes; theoretical questions and calculations	Process Engine - d O		
Assignment for the Following	General Engineering Science (German program): Specialisation I	0 0 1		
Curricula	General Engineering Science (German program): Specialisation I General Engineering Science (German program): Specialisation I		Compulsory	
	General Engineering Science (German program): Specialisation if General Engineering Science (German program, 7 semester): Spi	0,	, ,	
	General Engineering Science (German program, 7 semester): Spi General Engineering Science (German program, 7 semester): Spi		•	
		, , , , , ,		v.
	General Engineering Science (German program, 7 semester): Spi	eciansation Energy and Enviromental En	gmeering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory	wleen,		
	Energy and Environmental Engineering: Core qualification: Comp			
	General Engineering Science (English program): Specialisation E			
	General Engineering Science (English program): Specialisation E		ompulsory	
	General Engineering Science (English program): Specialisation F			
	General Engineering Science (English program, 7 semester): Spe		•	
	General Engineering Science (English program, 7 semester): Spe	, , , , , , , , , , , , , , , , , , , ,		
	General Engineering Science (English program, 7 semester): Spe	ecialisation Energy and Enviromental En	gineering: Compulsory	1
	Process Engineering: Core qualification: Compulsory			



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	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	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie</li> </ul>



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



Course L0141: Thermal Separation	Processes	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	Introduction in the thermal process engineering and to the main features of separation processes  Simple equilibrium processes, several steps processes  Distillation of binary mixtures, enthalpy-concentration diagrams  Extractive and azeotrope distillation, water vapor distillation, stepwise distillation  Extraction: separation ternary systems, ternary diagram  Multiphase separation including complex mixtures  Designing of separation devices without discrete stages  Drying  Chromatographic separation processes  Membrane separation  Energy demand of separation processes  Advance overview of separation processes  Selection of separation processes	
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie</li> </ul>	



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



Module M0892: Chemical 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 Engineerin	g (Fundamentals) (L0221)	Laboratory Course	2	2	
Module Responsible	Prof. Raimund Horn				
Admission Requirements	None				
Recommended Previous	Contents of the previous modules mathematics I-III, physic	al chemistry, technical thermodynamics I+II as w	rell as computational r	nethods for engineers.	
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence	**	-			
Knowledge	The students are able to explain basic concepts of chemic	cal reaction engineering. They are able to point	out differences betwe	en thermodynamical and	
	kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties			•	
Skills	After successful completion of the module, students are ab	le to:			
	•				
	- apply different computational methods to dimension isoth	nermal and non-isothermal ideal reactors,			
	- determine and compute stable operation points for these	reactors,			
	- conduct experiments on a lab-scale pilot plants and docu	ment these according to scientific guidelines.			
Personal Competence					
Social Competence	After successful completition of the lab-course the stude	nts have a strong ability to organize themselfe	s in small groups to	solve issues in chemica	
cosia. competence	reaction engineering. The students can discuss their subje				
Autonomy	The students are able to obtain further information and a	* *		Idege discretely to plan	
, identify	prepare and conduct experiments.	access area reference actions modely. Stademo	can apply alon later	ladge alcolotely to plai	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following	General Engineering Science (German program): Speciali	ication Process Engineering: Compulsors			
Assignment for the Pollowing  Curricula	General Engineering Science (German program): Specialing General Engineering Gener				
Curricula	General Engineering Science (German program, 7 semes)		llcom/		
	General Engineering Science (German program, 7 semes	· · · · · · · · · · · · · · · · · · ·	•		
	Bioprocess Engineering: Core qualification: Compulsory	ier). Opecialisation bioprocess Engineering. Co	привогу		
	General Engineering Science (English program): Specialis	sation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Specialis				
	General Engineering Science (English program, 7 semest		llsorv		
	General Engineering Science (English program, 7 semest	, ,	-		
	Process Engineering: Core qualification: Compulsory				

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	
1	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, ine 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)	
1	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relative between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)	
1	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standar heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemic equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reactions systems, Lagrange Multipliers)	
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanismicrokinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and p exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integrethed of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, relimiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complexinetics)	



single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors).

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

## Literature

lecture notes Raimund Horn

skrint 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
- $\hbox{H.\,S.\,Fogler,\,Essentials\,of\,Chemical\,\,Reaction\,\,Engineering,\,Prentice\,\,Hall}$
- 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
- $\hbox{M.\,E.\,Davis,\,R.\,J.\,Davis,\,Fundamentals\,of\,Chemical\,\,Reaction\,\,Engineering,\,McGraw\,\,Hill}$
- 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



ırse L0244: Chemical Reaction E	Ingineering (Fundamentals)
	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 DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, iner
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mas 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, line 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 thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standar heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemic equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism microkinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and prexponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integrated of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rallimiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactor single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stage reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of 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 cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exotherm reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer tonvection, 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-isotherm 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



Course L0221: Experimental Course Chemical Engineering (Fundamentals)		
Тур	Laboratory Course	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch	
Language	DE/EN	
Cycle		
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 be 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. 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: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technol	ogy (L1387)	Laboratory Course	1	1
Environmental Technologie (L0326)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound	knowledge of environmental technological	gy. They are able to de	escribe the behaviour of
	chemicals in the environment. Students can give an overview of	f scientific disciplines involved. They	can explain terms and	allocate them to related
	methods.			
Skille	Students are able to propose appropriate management and mitig	ation maggires for anyironmental pro	blome. Thoy are able to	dotormino goodhomical
Skills	parameters and to assess the potential of pollutants to migrate			
	Environmental Technology contributes to sustainable developmen			·
	Environmental recimiology contributes to sustainable developmen	n, and they can present and determ th	osc opinions in none or a	na agamet the group.
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different			
	approaches to the task as a group as well as to discuss their theoretical or practical implementation.			
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge and transer it to new problems.			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisation E	Energy and Enviromental Engineering	Compulsory	
Curricula	General Engineering Science (German program): Specialisation F	Process Engineering: Elective Compul	sory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Energy and Enviromental I	Engineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Spe	ecialisation Process Engineering: Elec	tive Compulsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Bioprocess Engineering: E	lective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Process Engineering: Elective Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			/
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory			
	Process Engineering: Core qualification: Elective Compulsory			

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



Course L0326: Environmental Technologie		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)	



	ent Technology for Mechanical and Process En			
Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Control	rol Systems (L1119)	Laboratory Course	2	2
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1
Module Responsible	Dr. Sven Krause			
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering	ng		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundmentals of	the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static a
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for dif	forant kinds of quantities to be massured	(Floatrical Quantities	Fomporaturo mochani
	quantities, Flow, Time, Frequency).	leterit killus of quantities to be maesured	(Liectical Quantities,	remperature, mechani
	quantities, flow, fille, frequency).			
	They can describe important methods of chemical Analysis (Ga	s Sensors, Spectroscopy, Gas Chromatog	raphy)	
Skills	Students can select suitable measuring methods to given proble	ems and can use refering measurement de	evices in practice.	
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into			
	the right context and application area.			
Personal Competence				
Social Competence Students can arrive at work results in groups and document them in a common report.				
	3 channel and a contract of the contract of th			
Autonomy	Students are able to familiarize themselves with new measuren	nent technologies.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisatio		Compulsory	
Curricula	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program): Specialisatio			
	General Engineering Science (German program, 7 semester):			У
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory  General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation		ompulsory	
General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program): Specialisation Process Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
		v		
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory			,	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory				
	Mechanical Engineering: Core qualification: Compulsory	pos.aoation i roocos Engineening. Comp	u,	
Mechatronics: Core qualification: Compulsory				
	Process Engineering: Core qualification: Compulsory			



Course L1119: Practical Course: Me	easurement and Control Systems	
Тур	Laboratory Course	
Hrs/wk	2	
CP	s Independent Study Time 32, Study Time in Lecture 28	
Workload in Hours		
Lecturer		
Language		
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	Versuch 1:	
	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>	
	Versuch 2:  • Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren	
	<ul> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> </ul>	
<ul> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>		
	Versuch 4:	
	<ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>	



Course L1116: Measurement Technology for Mechanical and Process Engineers		
Тур	Typ Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours		
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle		
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	
	4 Chemical Analysis	
	4.1 Gas Sensors	
	4.2 Spectroscopy	
	4.3 Gas Chromatography	
	At the end of each lecture students present single measuring techniques and results orally in front of the class.	
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 and Process Engineers	
Typ Recitation Section (large)	
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Sven Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0539: Process an	d Plant Engineering I			
wodule woods. Process an	a Flant Engineering i			
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. Georg Fieg			
Admission Requirements	none			
Recommended Previous	unit operation of thermal an dmechanical separation processes			
Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical processe	s		
	specify linear component equations of complex chemical processes			
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	formulation of mass and energy balance equations and estimation of product streams			
	estimation of component streams of chemical plants using linear component balance models			
	solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of production of	- economic evaluation of processes and the estimation of production costs		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following	General Engineering Science (German program): Specialisation Proc	ess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Biop	rocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Special	isation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory			
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Speciali			
	General Engineering Science (English program, 7 semester): Speciali	sation Energy and Enviromental Eng	ineering: Elective Cor	mpulsory
	Process Engineering: Core qualification: Compulsory			

Course L0095: Process and Plant Engineering I		
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	Se	
Content	1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants  2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression	



Module Manual B. Sc.	. "General Engineering Science (English program)"	TUHH xhnische Universität Hamburg-Ha
	Data reconciliation and data validation  3. Process Synthesis  Decision levels  Experimental process development  Reactor synthesis  Synthesis of separation processes (process alternatives and criteria for selection)  Integration of reaction systems/separation systems (interactions, recycle streams)  4. Process safety  5. Cost estimation of production plants  Production costs, capital costs, economic evaluation	
Literature		
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679	
	H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74	
	Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157	
	E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997	
	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916	
	R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte,	
	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004	
	J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988	
	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19	
	G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306	
	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213	
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133	
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2	000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991	
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001	
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg	
	D. Hairston, Chemical Engineering, October 2001, S. 31-37	
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002	
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511	
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824	
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169	
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309	
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fleg, Fett/Lipid 100/1998), Nr. 12, S. 528-534	

P. Li, M. Flender, K. Löwe, G.	Wozny, G. Fieg, Fett/Lipid	100(1998), Nr. 12,	S. 528-534
G. Kaibel, Dissertation, TU Mi	inchen, 1987		

G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112

G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98

H.J. Lang, Chem. Eng. 54(10),117, 1947

H.J. Lang, Chem. Eng. 55(6), 112, 1948

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

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



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



Module M0670: Particle Ted	chnology and Solids Process Engineering			
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)				2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	<ul> <li>name and explain processes and unit-operations of soli</li> </ul>	ds process engineering,		
	<ul> <li>characterize particles, particle distributions and to discus</li> </ul>			
Skills	Students are able to			
	choose and design apparatuses and processes for solid	s processing according to the desired solid	ds properties of the pro	oduct
	asses solids with respect to their behavior in solids proce	essing steps		
	<ul> <li>document their work scientifically.</li> </ul>			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with other students or scientific personal and to develop solutions for technical-scientific issues in			
	a group.			
Autonomy	a group.  Students are able to analyze and solve questions regarding solid particles independently.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	n Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	n Energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program, 7 semester): S	specialisation Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7 semester): S	specialisation Bioprocess Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): S	specialisation Energy and Enviromental En	gineering: Compulsor	γ
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Cor	npulsory		
	General Engineering Science (English program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (English program): Specialisation	Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Process Engineering: Compu	llsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Bioprocess Engineering: Con	npulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Energy and Enviromental Eng	gineering: Compulsor	у
	Process Engineering: Core qualification: Compulsory			



Course L0434: Particle Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology I		
Тур	Recitation Section (small)	
Hrs/wk	1	
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 Technology	I
Тур	Laboratory Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Courses				
ïtle		Тур	Hrs/wk	CP
ntroduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	3	3
Module Responsible	Prof. Christoph Ihl	1 Toblem-based Learning		3
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following leading to the following lea	earning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of ma Marketing and Innovation, and also to Investment and Controlling. In		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management     ield of Management     explain the most important aspects of and goals in Manager     describe and explain basic business functions as productions.	nent and name the most important asp	ects of entreprneurial p	projects
	ressource management, information management, innovatio  explain the relevance of planning and decision making in some basic methods from mathematical Finance  estate basics from accounting and costing and selected contr	Business, esp. in situations under mu	Iltiple objectives and	uncertainty, and expla
Skills	Students are able to analyse business units with respect to	•	ctives, strategies etc	.) and to carry out
	Entrepreneurship project in a team. In particular, they are able to     analyse Management goals and structure them appropriatel	y		
	analyse organisational and staff structures of companies	and the same of the same days days days		
	<ul> <li>apply methods for decision making under multiple objective:</li> <li>analyse production and procurement systems and Business</li> </ul>			
	analyse production and procurement systems and business     analyse and apply basic methods of marketing	mornation systems		
	select and apply basic methods from mathematical finance t	predefined problems		
	apply basic methods from accounting, costing and controlling.	g 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 entrepreneur	ship project and write a coherent repor	t 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			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Ele	ectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Co			
	General Engineering Science (German program): Specialisation Pr General Engineering Science (German program): Specialisation Bir			
	General Engineering Science (German program): Specialisation En		ompulsory	
	General Engineering Science (German program): Specialisation Ci	vil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Me	chanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program): Specialisation Na			
	General Engineering Science (German program, 7 semester): Spec General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec		•	
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	ialisation Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec		•	
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): S		•	
	0			
	Compulsory			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering	, Focus Theoretical M	Mechanical Engineerii



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

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

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

 $General\ Engineering\ Science\ (English\ program, 7\ semester):\ Specialisation\ Electrical\ Engineering:\ Compulsory$ 

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

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

Computational Science and Engineering: Core qualification: Compulsory

 $Logistics\ and\ Mobility: Core\ qualification: Compulsory$ 

 $\label{thm:mechanical engineering: Core qualification: Compulsory} Mechanical Engineering: Core qualification: Compulsory$ 

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



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

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



## Thesis

Module M-001: Bachelor Th	nesis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	Froiessoleti del Totili
Admission requirements	According to General Regulations §24 (1):
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	The lang part secondary, seasons have reached the following reading reached
Knowledge	
rinomougo	The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (fact)
	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 are considered to the students are capable in relation to a specific issue of opening up are considered.
	establishing links with extended specialized expertise.
	The students are able to outline the state of research on a selected issue in their subject area.
Skills	
	<ul> <li>The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-relate problems.</li> </ul>
	<ul> <li>With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, ar</li> </ul>
	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	
	<ul> <li>Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> <li>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 the</li> </ul>
	can uphold their own assessments and viewpoints convincingly.
	can opnice ston our account and volponic community.
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.
	<ul> <li>The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.</li> <li>The students can apply the essential techniques of scientific work to research of their own.</li> </ul>
	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
Examination	according to Subject Specific Regulations
Examination duration and scale	
Assignment for the Following	
Curricula	
	Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory
	Computer Science: Thesis: Compulsory
	Electrical Engineering: Thesis: Compulsory
	Energy and Environmental Engineering: Thesis: Compulsory
	General Engineering Science (English program): Thesis: Compulsory
	General Engineering Science (English program, 7 semester): Thesis: Compulsory
	Computational Science and Engineering: Thesis: Compulsory
	Logistics and Mobility: Thesis: Compulsory
	Mechanical Engineering: Thesis: Compulsory
	Mechatronics: Thesis: Compulsory
	Naval Architecture: Thesis: Compulsory
	Technomathematics: Thesis: Compulsory
	xx: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory