

# **Module Manual**

Bachelor of Science

# General Engineering Science (German program)

Cohort: Winter Term 2015

Updated: 23rd January 2017

# **Table of Contents**

Table of Contents	2
Program description	5
Core qualification	6
Module M0577: Nontechnical Complementary Courses for Bachelors	6
Module M0642: Physics for Engineers	8
Module M0687: Chemistry	10
Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields	12
Module M0889: Mechanics I (Statics)	13
Module M0850: Mathematics I	15
Module M0547: Electrical Engineering II: Alternating Current Networks and Basic Devices	18
Module M0594: Fundamentals of Mechanical Engineering Design	21
Module M0671: Technical Thermodynamics I  Module M0696: Mechanics II: Mechanics of Materials	25
Module M0851: Mathematics II	27
Module M1121: Programming in C	30
Module M0959: Mechanics III (Hydrostatics, Kinematics, Kinetics I)	32
Module M0688: Technical Thermodynamics II	34
Module M0730: Computer Engineering	36
Module M0853: Mathematics III	39
Module M1121: Programming in C	42
Module M0833: Introduction to Control Systems	44
Specialization Civil- and Enviromental Engeneering	47
Module M0740: Structural Analysis I	47
Module M0613: Reinforced Concrete I	49
Module M0706: Geotechnics I	51
Module M0672: Signals and Systems	53
Module M0744: Structural Analysis II	55
Module M0829: Foundations of Management	57
Module M0580: Principles of Building Materials and Building Physics	60
Module M0611: Steel Structures I  Module M0631: Concrete Structures II	62
Module M0728: Hydraulic Engineering I	66
Module M0755: Geotechnics II	68
Module M0686: Sanitary Engineering	70
Module M0869: Hydraulic Engineering II	73
Specialization Energy and Environmental Engineering	75
Module M0598: Mechanical Engineering: Design	75
Module M0957: Introduction into Energy and Environmental Engineering	78
Module M0536: Fundamentals of Fluid Mechanics	80
Module M0610: Electrical Machines	82
Module M0618: Renewables and Energy Systems	84
Module M0829: Foundations of Management	86
Module M0538: Heat and Mass Transfer	89
Module M0546: Thermal Separation Processes	91
Module M0956: Measurement Technology for Mechanical and Process Engineers	96
Module M0639: Gas and Steam Power Plants	99
Module M0933: Fundamentals of Materials Science	102
Module M1275: Environmental Technology	104
Module M0670: Particle Technology and Solids Process Engineering	106
Module M1274: Environmental Technology	108
Specialization Biomedical Engineering	
Module M0933: Fundamentals of Materials Science Module M0634: Introduction into Medical Technology and Systems	110
Module M0634: Introduction into Medical Technology and Systems  Module M0672: Signals and Systems	114
Module M0680: Fluid Dynamics	116
Module M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)	118
Module M1277: MED I: Introduction to Anatomy	120
Module M1278: MED I: Introduction to Radiology and Radiation Therapy	122
Module M0598: Mechanical Engineering: Design	124
Module M0646: BIO I: Implants and Testing	127
Module M0662: Numerical Mathematics I	129
Module M0684: Heat Transfer	131
Module M0956: Measurement Technology for Mechanical and Process Engineers	133
Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	136
Module M0829: Foundations of Management	137
Module M1280: MED II: Introduction to Physiology	140
Specialization Naval Architecture	141
Module M0933: Fundamentals of Materials Science	141
Module M0829: Foundations of Management  Module M0854: Mathematics IV	143
INDUADO INDUAT. INBITICITATIO IV	140

	le M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Syste	
	le M0680: Fluid Dynamics	151
	le M0640: Stochastics and Ship Dynamics le M0655: Computational Fluid Dynamics I	153
	le M0659: Fundamentals of Ship Structural Design and Analysis	1 <u>56</u> 158
	le M0664: Structural Design and Construction of Ships	161
	le M1118: Hydrostatics and Body Plan	164
	le M1109: Resistance and Propulsion	167
Module	le M1110: Ship Design	168
Speciali	alization Bioprocess Engineering	170
Module	le M0886: Fundamentals of Process Engineering	170
	le M0937: Physical Chemistry	172
	le M0536: Fundamentals of Fluid Mechanics	174
	le M0544: Phase Equilibria Thermodynamics	176
	le M0672: Signals and Systems	179
	le M0757: Biochemistry and Microbiology le M0829: Foundations of Management	<u>181</u> 184
	le M0938: Bioprocess Engineering - Fundamentals	187
	le M0538: Heat and Mass Transfer	189
	le M0546: Thermal Separation Processes	191
	le M0892: Chemical Reaction Engineering	196
Module	le M0945: Bioprocess Engineering - Advanced	200
	le M0539: Process and Plant Engineering I	202
	le M0670: Particle Technology and Solids Process Engineering	205
Speciali	alization Electrical Engineering	207
Module	le M0708: Electrical Engineering III: Circuit Theory and Transients	207
	le M0567: Theoretical Electrical Engineering I: Time-Independent Fields	209
	le M0748: Materials in Electrical Engineering	212
	le M0672: Signals and Systems	216
	le M0709: Electrical Engineering IV: Transmission Lines and Research Seminar	218
	le M0734: Electrical Engineering Project Laboratory	220
	le M0854: Mathematics IV	221
	le M0675: Introduction to Communications and Random Processes le M0568: Theoretical Electrical Engineering II: Time-Dependent Fields	
	le M0783: Measurements: Methods and Data Processing	229
	le M0760: Electronic Devices	231
	le M0777: Semiconductor Circuit Design	233
	le M0829: Foundations of Management	235
	alization Computer Science	238
	le M0561: Discrete Algebraic Structures	238
Module	le M0553: Objectoriented Programming, Algorithms and Data Structures	239
Module	le M0624: Logic, Automata and Formal Languages	241
Module	le M0672: Signals and Systems	243
	le M0829: Foundations of Management	245
	le M0852: Graph Theory and Optimization	248
	le M0662: Numerical Mathematics I	250
	le M0793: Seminars Computer Science and Mathematics	252
	le M0791: Computer Architecture	0.50
	le M0834: Computernetworks and Internet Security	050
	le M0731: Functional Programming le M0727: Stochastics	260
	lo M0071: Operating Systems	262
	plization Machanical Engineering	262
	la MOFOO: Machanical Engine aging: Darian	000
	le M0933: Fundamentals of Materials Science	266
Module	le M0610: Electrical Machines	268
	le M0865: Fundamentals of Production and Quality Management	
	le M0672: Signals and Systems	272
Module	le M0680: Fluid Dynamics	274
	le M0934: Advanced Materials	276
	le M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Syste	
		280
	le M0829: Foundations of Management	
	Biomechanics	
Module	le M1277: MED I: Introduction to Anatomy	286
	le M1278: MED I: Introduction to Radiology and Radiation Therapy	200
	le M0646: BIO I: Implants and Testing	
	le M0662: Numerical Mathematics I le M0684: Heat Transfer	292 294
	la M1070, MED II, Introduction to Dischamistry and Malaguer Dischami	000
	lo M1090; MED II; Introduction to Physiology	207
	Energy Systems	298
	le M0597: Advanced Mechanical Engineering Design	298
	le M0655: Computational Fluid Dynamics I	301

Module M0639: Gas and Steam Power Plants	303
Module M0684: Heat Transfer	306
Module M1022: Reciprocating Machinery	308
Focus Aircraft Systems Engineering	311
Module M0597: Advanced Mechanical Engineering Design	311
Module M0596: Advanced Mechanical Design Project	314
Module M1320: Simulation and Design of Mechatronic Systems	316
Module M0599: Integrated Product Development and Lightweight Design	318
Module M0767: Aeronautical Systems	320
Focus Materials in Engineering Sciences	322
Module M0597: Advanced Mechanical Engineering Design	322
Module M0988: Structural Materials	325
Module M0662: Numerical Mathematics I	327
Module M1009: Material Science Laboratory	329
Module M1005: Enhanced Fundamentals of Materials Science	331
Focus Mechatronics	334
Module M0597: Advanced Mechanical Engineering Design	334
Module M0708: Electrical Engineering III: Circuit Theory and Transients	337
Module M1320: Simulation and Design of Mechatronic Systems	339
Module M0777: Semiconductor Circuit Design	341
Module M0854: Mathematics IV	343
Focus Product Development and Production	346
Module M0597: Advanced Mechanical Engineering Design	346
Module M0596: Advanced Mechanical Design Project	349
Module M1009: Material Science Laboratory	351
Module M0726: Production Technology	353
Module M0599: Integrated Product Development and Lightweight Design	356
Focus Theoretical Mechanical Engineering	358
Module M0597: Advanced Mechanical Engineering Design	358
Module M0596: Advanced Mechanical Design Project	361
Module M0684: Heat Transfer	363
Module M1320: Simulation and Design of Mechatronic Systems	365
Module M0854: Mathematics IV	367
Specialization Process Engineering	370
Module M0886: Fundamentals of Process Engineering	370
Module M0937: Physical Chemistry	372
Module M0536: Fundamentals of Fluid Mechanics	374
Module M0544: Phase Equilibria Thermodynamics	376
Module M0672: Signals and Systems	379
Module M0891: Informatics for Process Engineers	381
	384
Module M0938: Bioprocess Engineering - Fundamentals	386
Module M1274: Environmental Technology	200
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer	388
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes	390
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering	390 395
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology	390 395 399
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology Module M0956: Measurement Technology for Mechanical and Process Engineers	390 395 399 401
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology Module M0956: Measurement Technology for Mechanical and Process Engineers Module M0539: Process and Plant Engineering I	390 395 399 401 404
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology Module M0956: Measurement Technology for Mechanical and Process Engineers Module M0539: Process and Plant Engineering I Module M0670: Particle Technology and Solids Process Engineering	390 395 399 401 404 407
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology Module M0956: Measurement Technology for Mechanical and Process Engineers Module M0539: Process and Plant Engineering I Module M0670: Particle Technology and Solids Process Engineering Module M0829: Foundations of Management	390 395 399 401 404 407 409
Module M1274: Environmental Technology Module M0538: Heat and Mass Transfer Module M0546: Thermal Separation Processes Module M0892: Chemical Reaction Engineering Module M1275: Environmental Technology Module M0956: Measurement Technology for Mechanical and Process Engineers Module M0539: Process and Plant Engineering I Module M0670: Particle Technology and Solids Process Engineering	390 395 399 401 404 407



# **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.

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# Core qualification

Module M0577: Nontechnical Complementary Courses for Bachelors			
Module Responsible	Module Responsible Dagmar Richter		
Admission Requirements	None		
Recommended Previous	None		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			

#### Knowledge The Non-technical Elective Study Area

imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, selfmanagement, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical 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" follow the specific profiling of TUHH degree courses.

The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles"

The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of

#### **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 interdisciplinarity 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 studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.

The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.

# The Competence Level

of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of

This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life

# Specialized Competence (Knowledge)

# Students can

- locate selected specialized areas with the relevant non-technical mother discipline.
- outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,
- different specialist disciplines relate to their own discipline and differentiate it as well as make connections.
- sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,
- Can communicate in a foreign language in a manner appropriate to the subject.

# 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,
- to handle simple questions in aforementioned scientific disciplines in a sucsessful manner.
- justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.

# Personal Competence

Social Competence

# Personal Competences (Social Skills)

Students will be able

- to learn to collaborate in different manner.
- to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,



	<ul> <li>to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul>
Autonomy	Personal Competences (Self-reliance) Students are able in selected areas
	<ul> <li>to reflect on their own profession and professionalism in the context of real-life fields of application</li> <li>to organize themselves and their own learning processes</li> <li>to reflect and decide questions in front of a broad education background</li> <li>to communicate a nontechnical item in a competent way in writen form or verbaly</li> <li>to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li> </ul>
Workload in Hours	Depends on choice of courses
Credit points	6

# Courses

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



Module M0642: Physics for	Engineers			
Courses				
Title		Тур	Hrs/wk	CP
Physics for Engineers (L0367)		Lecture	2	3
Physics for Engineers (Problem Solving C	ourse) (L0368)	Recitation Section (small)	1	1
Physics-Lab for ET/ AIW/ GES (L0948)		Laboratory Course	1	2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous				
Knowledge	Calculus and linear algebra on high school level			
	Physics on high school level			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics s	uch as in the areas of mechanics, oscillation	s,	
	waves, and optics.			
	Students can relate physics topics to technical problems.			
Skills	Students can describe physical problems mathematically and solve such problems within the framework of			
	their acquired mathematical expertise.			
	Students are able to write meaningful reports on experiments and to discuss the results in a conclusive way.			
Personal Competence				
•	Students can idinthy calve aubicat related problems in groups 7	Thou and propert their regults offertively		
Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively			
	within the framework of the problem solving and lab courses.			
Autonomy	Students are capable to extract relevant information from the			•
	reflect their acquired level of expertise with the help of lectur		typical exam questio	ns. 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	Written Exam: 120 minutes. Physics Lab: 4 handwritten pages	preparatory script, assisted transcript and att	estation.	
Assignment for the Following	General Engineering Science (German program): Core qualific	ation: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory			
				<u> </u>

Course L0367: Physics for Engineers			
Тур	ecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Manfred Eich		
Language	DE		
Cycle	WiSe		
Content	<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>Giancoli, Physics for Scientists &amp; Engineers Vol. 1, 2, Pearson</li> <li>Halliday/Resnik/Walker, Fundamentals of physics, Wiley</li> <li>K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, Wiley</li> <li>Gerthsen/Vogel, Physik, Springer Verlag</li> <li>Hering/Martin/Stohrer, Physik für Ingenieure, VDI-Verlag</li> </ul>		



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

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.	



Madula M0007, Chamiator				
Module M0687: Chemistry				
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Courses				
Γitle		Тур	Hrs/wk	CP
Chemistry I (L0460)		Lecture	2	2
Chemistry I (L0475)		Recitation Section (large)	1 2	1 2
Chemistry II (L0465) Chemistry II (L0476)		Lecture 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 results		
Professional Competence				
Knowledge	The students are able to name and to describe basic	principles and applications of general chemistry	(structure of matter,	periodic table, chemica
	bonds), physical chemistry (aggregate states, separat	ing processes, thermodynamics, kinetics), ino	rganic chemistry (ac	d/base, pH-value, salt
	solubility, redox, metals) and organic chemistry (alipha	atic hydrocarbons, functional groups, carbonyl	compounds, aromate	s, reaction mechanisms
	natural products, synthetic polymers). Furthermore studer		,	
Skills	After successful completion of this module students are able to describe substance groups and chemical compounds. On this basis, they are capable of explaining, choosing and applying specific methods and various reaction mechanisms.			
Personal Competence				
Social Competence	Students are able to take part in discussions on chemical issues and problems as a member of an interdisciplinary team. They can contribute to those			
	discussion by their own statements.			
Autonomy	After successful completion of this module students ar	e able to solve chemical problems independe	ntly by defending pro	posed approaches wit
	arguments. They can also document their approaches.			
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): Core q	ualification: Compulsory		
Curricula	Civil- and Environmental Engineering: Core qualification	Compulsory		
	Technomathematics: Specialisation Engineering Science	: Flective Compulsory		

Course L0460: Chemistry I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language		
Cycle	WiSe	
Content	- Structure of matter	
	- Periodic table	
	- Electronegativity	
	- Chemical bonds	
	- Solid compounds and solutions	
	- Chemistry of water	
	- Chemical reactions and equilibria	
	- Acid-base reactions	
	- Redox reactions	
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure	
	- Kickelbick: Chemie für Ingenieure (Pearson)	
	- Mortimer: Chemie. Basiswissen der Chemie.	
	- Brown, LeMay, Bursten: Chemie. Studieren kompakt.	



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

Course L0	Course L0465: Chemistry II		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload	Independent Study Time 32, Study Time in Lecture 28		
in Hours			
Lecturer	Dr. Christoph Wutz		
Language	DE		
Cycle	• WiSe		
Content	t - Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,		
	- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars		
	- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction		
	- Practical apllications and examples		
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure		
	- Kickelbick: Chemie für Ingenieure (Pearson)		
	- Schmuck: Basisbuch Organische Chemie (Pearson)		

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



Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields				
Courses				
Title		Тур	Hrs/wk	CP
	tworks and Electromagnetic Fields (L0675)	Lecture	3	5
Electrical Engineering I: Direct Current Ne	tworks and Electromagnetic Fields (L0676)	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 fo	ollowing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	zweistündig			
Assignment for the Following	General Engineering Science (German program): Core qualification: Compulsory			
Curricula	Electrical Engineering: Core qualification: Compulsory			
	Computational Science and Engineering: Core qualification	n: Compulsory		
1	Mechatronics: Core qualification: Compulsory			

Course L0675: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields		
	Lecture	
Hrs/wk		
СР	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Manfred Kasper	
Language	DE	
Cycle	WiSe	
Content		
Literature	<ol> <li>M. Kasper, Skript zur Vorlesung Elektrotechnik 1, 2013</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> <li>A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008</li> </ol>	

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



Module M0889: Mechanics	I (Station)			
nodule Midoos. Mechanics	(Statics)			
ourses				
ïtle		Тур	Hrs/wk	СР
Mechanics I (Statics) (L1001)		Lecture	2	3
Mechanics I (Statics) (L1002)		Recitation Section (small)	2	2
flechanics I (Statics) (L1003)		Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Elementary knowledge in mathematics and phys	sics		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	ched the following learning results		
Professional Competence				
Knowledge	The students can			
	describe the evicement precedure used in	a machanical contouts		
	describe the axiomatic procedure used in			
	explain important steps in model design;			
	present technical knowledge in stereosta	itics.		
Skills	Skills The students can			
	explain the important elements of mathen	natical / mechanical analysis and model formation, and ap-	ply 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 proble</li> <li>apply basic statical methods to engineering problems;</li> </ul>			aren enn presieme	
	estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets.			
	estinate the reach and boundaries of star	ilical methods and extend them to be applicable to wider pr	obiem sets.	
Personal Competence				
Social Competence	The students can work in groups and support each other to overcome difficulties.			
Autonomy	Students are canable of determining their own et	trengths and weaknesses and to organize their time and le	arning based on thos	20
Autonomy	olddenis are capable of determining their own st	tiengtis and weakiesses and to organize their time and re	arriing based on thos	
Workload in Hours	Workload in Hours Independent Study Time 110, Study Time in Lecture 70			
Credit points	Credit points 6			
Examination	Examination Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program)	): Core qualification: Compulsory	<del></del>	
Curricula	Civil- and Environmental Engineering: Core qual	lification: Compulsory		
	Mechanical Engineering: Core qualification: Con	npulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulso	ory.		

Course L1001: Mechanics I (Statics)		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	Forces and equilibrium	
	Constraints and reactions	
	Frames	
	Center of mass	
	Friction	
	Internal forces and moments for beams	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).	
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1.11. Auflage, Springer (2011).	

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



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



Module M0850: Mathematic	es I			
Courses				
Title		Тур	Hrs/wk	CP
Analysis I (L1010)		Lecture	2	2
Analysis I (L1012)		Recitation Section (small)	1	1
Analysis I (L1013)		Recitation Section (large)	1	1
Linear Algebra I (L0912)		Lecture	2	2
Linear Algebra I (L0913) Linear Algebra I (L0914)		Recitation Section (small) Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz	riecitation Section (large)	'	
Admission Requirements	none			
Recommended Previous	School mathematics			
Knowledge	School matternatics			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence		· · · · ·		
Knowledge				
1.0090	Students can name the basic concepts in analysis and lin			
	Students can discuss logical connections between these     The unique standard actions and converge discuss these	concepts. They are capable of illustrating	tnese connections w	ith the help of examples.
	They know proof strategies and can reproduce them.			
Skills	Students can model problems in analysis and linear algorates.	ahra with the help of the concents studies	Lin this course More	over they are canable of
	solving them by applying established methods.	ebra with the help of the concepts studied	in this course. More	over, triey are capable or
		anastiana batusan the concepts at idiad in	the course	
	Students are able to discover and verify further logical co			
	For a given problem, the students can develop and execu-	ite a suitable approach, and are able to cri	itically evaluate the re	esults.
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			
	check and deepen the understanding of their peers.			
Autonomy				
ridionomy	Students are capable of checking their understanding of	complex concepts on their own. They ca	an specify open ques	tions precisely and know
	where to get help in solving them.			
	Students have developed sufficient persistence to be able	e to work for longer periods in a goal-orien	ited manner on hard	problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points				
Examination				
Examination duration and scale	60 min (Analysis I) + 60 min (Linear Algebra I)			
Assignment for the Following	General Engineering Science (German program): Core qualification: Compulsory			
Curricula	Civil- and Environmental Engineering: Core qualification: Compu	ulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	Computational Science and Engineering: Core qualification: Cor			
	Logistics and Mobility: Core qualification: Compulsory	P		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory			



Course L1010: Analysis I				
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	Foundations of differential and integrational calculus of one variable			
	statements, sets and functions     natural and real numbers     convergence of sequences and series     continuous and differentiable functions     mean value theorems     Taylor series     calculus     error analysis     fixpoint iteration			
Literature	<ul> <li>R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 1. Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000</li> <li>H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen. Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000.</li> </ul>			

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

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

Course L0912: Linear Algebra I		
Тур	octure	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Anusch Taraz	
Language	E	
Cycle	NiSe	
Content	<ul> <li>vectors: intuition, rules, inner and cross product, lines and planes</li> <li>general vector spaces: subspaces, isomorphic spaces, Euclidean vector spaces</li> <li>systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants</li> </ul>	
Literature	<ul> <li>W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>	



Course L0913: Linear Algebra I	ourse L0913: Linear Algebra I	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Anusch Taraz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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



Module M0547: Electrical E	ngineering II: Alternating Current Networks	and Basic Devices		
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering II: Alternating Curre	nt Networks and Basic Devices (L0178)	Lecture	3	5
Electrical Engineering II: Alternating Curre	nt Networks and Basic Devices (L0179)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous	Direct current networks, complex numbers			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence	3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 3		
Knowledge	Students are able to reproduce and explain fundamental	theories, principles, and methods related	I to the theory of altern	ating currents. Thev ca
· ·	describe networks of linear elements using a complex nota			
	of alternating currents in the area of electrical engineering.	Students are capable of explaining the bel	navior of fundamental pa	assive and active device
	as well as their impact on simple circuits.			
Skills	Students are capable of calculating parameters within simp			
	currents. They can appraise the fundamental effects that ma		-	
	circuits such as oscillating circuits, filter, and matching net justify the fundamental elements of an electrical power sup			•
	are qualified to dimension their main features.	pry (transformer, transmission line, compen	sation of reactive power	, muniphase system) an
Personal Competence				
Social Competence	Students are able to work together on subject related tasks	n small groups. They are able to present the	eir results effectively (e.g	. during a week of projec
	work).			
A t	Charles to any season blocks south an account in factor of the season in factor of the season of the			the leature. They are all
Autonomy	Students are capable to gather necessary information from to continually reflect their knowledge by means of activities			
	Based on respective feedback, students are expected to	• •		
	knowledge obtained in this lecture and the content of other		•	
			g : 2:4, 4:12 : <b>4()</b>	
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): Core qua	lification: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory			
	Computational Science and Engineering: Core qualification	: Compulsory		
	Mechatronics: Core qualification: Compulsory			



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



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



Module M0594: Fundament	tals of Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanical Engineering	Design (L0258)	Lecture	2	3
Fundamentals of Mechanical Engineering	Design (L0259)	Recitation Section (large)	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Basic knowledge about mechanics and production engineering	n		
Knowledge	Internship (Stage I Practical)	9		
	internet (caage it raction)			
Educational Objectives	After taking part successfully, students have reached the following lear	rning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	<ul> <li>explain basic working principles and functions of machine eler</li> </ul>	nents,		
	explain requirements, selection criteria, application scenarios		machine elements, in	dicate the background of
	dimensioning calculations.			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered machine ele	ments,		
	transfer knowledge learned in the module to new requirements	and tasks (problem solving skills)	,	
	recognize the content of technical drawings and schematic ske	tches,		
	technically evaluate basic designs.			
Personal Competence				
Social Competence				
	Students are able to discuss technical information in the lecture	e supported by activating methods.		
Autonomy				
,	Students are able to independently deepen their acquired known			
	Students are able to acquire additional knowledge and to related to the students are able to acquire additional knowledge and to related to the students.	ecapitulate poorly understood cor	ntent e.g. by using the	e 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: 0	Compulsory		
Curricula	Energy and Environmental Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Core qualification: C	ompulsory		
	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			
	. Samemanomanos. Soro quantoanom. Elective Compuisory			



_	Last via
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 design
	Introduction to design     Introduction to the following machine elements
	Screws
	Shaft-hub joints
	Rolling contact bearings
	Welding / adhesive / solder joints
	• Springs
	Axes & shafts
	Presentation of technical objects (technical drawing)
	1 Southail of Common Sojous (Common du du mig)
	Exercise
	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> </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

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



Module M0671: Technical T	hermodynamics I			
Courses				
Title		Тур	Hrs/wk	CP
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	g learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamic. They kn	ow the relation of the kinds of energy a	according to 1st law of	Thermodynamic and are
	aware about the limits of energy conversions according to 2 <sup>nd</sup> la		-	•
	variables and know the meaning of different state variables like			
	able to draw the Carnot cycle in a Thermodynamic related diagr		-	
	use the related equations of state. They know the meaning of a fi			
Skills	Students are able to calculate the internal energy, the enthalpy,	the kinetic and the potential energy as w	rell as work and heat fo	r simple change of states
	and to use this calculations for the Carnot cycle. They are able			
	variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an	approach.		
Autonomy	Students are able to define independently tasks, to get new know		as to find ways to use th	ne 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 qualifica	tion: Compulsory		
Curricula	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Core qualificat	ion: Compulsory		
	Computational Science and Engineering: Specialisation Engine	ering Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Election	ve Compulsory		
	Process Engineering: Core qualification: Compulsory			



T	Locture	
	Lecture 2	
Hrs/wk		
СР	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.)	
1.9		
Literature	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009	
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012	
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993	

Course L0439: Technical 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 M0696: Mechanics	II: Mechanics of Materials			
Courses				
Title		Тур	Hrs/wk	CP
Mechanics II (L0493)		Lecture	2	2
Mechanics II (L0494)		Recitation Section (small)	2	2
Mechanics II (L1691)		Recitation Section (large)	2	2
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	none			
Recommended Previous	Mechanics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law.			
Skills	The students apply the mathematical/mechanical ar	nalysis and modeling.		
	The students apply the fundamental methods of elast	sto statics to simply engineering problems.		
	The students estimate the validity and limitations of	the introduced methods.		
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	90 min			
Assignment for the Following	General Engineering Science (German program): C	ore qualification: Compulsory		
Curricula	Civil- and Environmental Engineering: Core qualific	ation: Compulsory		
	Mechanical Engineering: Core qualification: Compu	ılsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			

Course L0493: Mechanics II		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Swantje Bargmann	
Language	DE	
Cycle	SoSe	
Content	stresses and strains	
	Hooke's law	
	tension and compression	
	torsion	
	bending	
	stability	
	buckling	
	energy methods	
Literature	K. Magnus, H.H. Müller -Slany, Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2005)	
	D. Gross, W. Hauger, W. Schnell, J. Schröder, Technische Mechanik 1&2. 8. Auflage, Springer	
	(2004).	
	R.C. Hibbeler, Technische Mechanik	
	1&2. Pearson (2005)	

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



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



Module M0851: Mathematic	es II			
Courses				
Title		Тур	Hrs/wk	CP
Analysis II (L1025)		Lecture	2	2
Analysis II (L1026)		Recitation Section (large)	1	1
Analysis II (L1027)		Recitation Section (small)	1	1
Linear Algebra II (L0915)		Lecture	2	2
Linear Algebra II (L0916)		Recitation Section (small)	1	1
Linear Algebra II (L0917)	Dust Assess Toron	Recitation Section (large)	ı	ı
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous  Knowledge	Mathematics I			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		-		
Knowledge				
	<ul> <li>Students can name further concepts in analysis and linear</li> <li>Students can discuss logical connections between these of</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	Students can model problems in analysis and linear alger solving them by applying established methods.  Students are able to discover and verify further logical con For a given problem, the students can develop and execut	nections between the concepts studied in	the course.	
Personal Competence Social Competence	Students are able to work together in teams. They are cap:     In doing so, they can communicate new concepts according check and deepen the understanding of their peers.			can design examples to
Autonomy	Students are capable of checking their understanding of where to get help in solving them.     Students have developed sufficient persistence to be able			
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Examination	Written exam			
Examination duration and scale	60 min (Analysis II) + 60 min (Linear Algebra II)			
Assignment for the Following	General Engineering Science (German program): Core qualification	on: Compulsory		
Curricula	Civil- and Environmental Engineering: Core qualification: Comput			
Carrioula	Bioprocess Engineering: Core qualification: Compulsory	,		
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	nulsory		
	Computational Science and Engineering: Core qualification: Comp	*		
		ipuisory		
	Logistics and Mobility: Core qualification: Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory			



Course L1025: Analysis II		
Тур	ecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>power series and elementary functions</li> <li>interpolation</li> <li>integration (proper integrals, fundamental theorem, integration rules, improper integrals, parameter dependent integrals</li> <li>applications of integration (volume and surface of bodies of revolution, lines and arc length, line integrals</li> <li>numerical quadrature</li> <li>periodic functions</li> </ul>	
Literature	<ul> <li>R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 1; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000</li> <li>H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000.</li> </ul>	

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

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

Course L0915: Linear Algebra II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	<ul> <li>linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices</li> <li>linear regression: QR-decomposition, normal equations, linear discrete approximation</li> <li>eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition</li> <li>system of linear differential equations</li> </ul>
Literature	<ul> <li>W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>



Course L0916: Linear Algebra II	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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



Courses				
itle		Тур	Hrs/wk	CP
rogramming in C (L0083) rogramming in C (L1488)		Lecture Laboratory Course	1	1
Module Responsible	Prof. Siegfried Rump	Laboratory Course	'	'
Admission Requirements	None			
Recommended Previous	Elementary PC handling skills			
Knowledge	•			
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have reached the following learn	ning 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 elementary p	procedural programming		
	based on C programming and can explain them:			
	basic data types (integers, floating point numbers, characters)	han conversion)		
	<ul> <li>advanced data types (pointers, arrays, strings, composed data types, to operators (arithmetical operations, logical operations, bit operations)</li> </ul>	type conversion)		
	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 lectures like ob	ject oriented programming in C++.		
Skills	The students know how to use an integrated development environment	t 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 given C P	rograms.		
	They can solve simple algorithmic problems on their own and can mod in C language.	el and program their solutions		
	The students are able to solve selected exercises from other areas of the	neir study like mathematics,		
	mechanics, electrical engineering or physics with the aid of small C pro	grams/-projects numerically.		
Personal Competence				
Social Competence	The students are able to work in small teams to solve given weekly task	ss. to identify and analyze		
Coolai Compotence	programming errors and to present their results.	,		
		- DO		
	They are able to explain simple phenomena to each other directly at the	ero.		
Autonomy	The students prepare themselves using the given teaching material and	d solve the given		
	programming exercises on their own.			
	Additionally, they write small C programs to understand and check add	ressed issues and also to		
	gain a certain programming experience.			
	For details beyond the scope of the lecture the students inform themsel	ves using the stated		
	literature and / or by supplementary own research.	. 00 doing the otated		
	The state of the s			
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 qualification: C			
Curricula	General Engineering Science (English program): Core qualification: Co	ompuisory		



Course L0083: Programming in C	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE/EN
Cycle	SoSe
Content	C-Programming:
	basic data types (integers, floating point numbers, characters, boolean values)
	advanced data types (pointers, arrays, strings, composed data types, type conversion)
	3. operators (arithmetical operations, logical operations, bit operations)
	4. control flow (choice, loops, jumps, conditional compilation)
	5. functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes,
	functions with variable many arguments, macros, inline functions, modular design, function pointers)
	6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)
	7. example programs for technical and mathematical applications
Literature	Kernighan, Brian W (Ritchie, Dennis M.;)
	The C programming language
	ISBN: 9780131103702
	Upper Saddle River, NJ [u.a.]: Prentice Hall PTR, 2009
	Sedgewick, Robert
	Algorithms in C
	ISBN: 0201316633
	Reading, Mass. [u.a.]: Addison-Wesley, 2007
	Kaiser, Ulrich (Kecher, Christoph.;)
	C/C++: Von den Grundlagen zur professionellen Programmierung
	ISBN: 9783898428392
	Bonn: Galileo Press, 2010
	Walt Türgon
	Wolf, Jürgen C von A bis Z : das umfassende Handbuch
	ISBN: 3836214113
	Bonn : Galileo Press, 2009
	DOINT : Galliet 1 1655, 2000

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, Weitere Mitarbeiter	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Madula MOOFO, Machanica	III /Uudraatatiaa Kinamatiaa Kinatiaa	, N		
nodule Musss: Mechanics	III (Hydrostatics, Kinematics, Kinetics	51)		
ourses				
itle		Тур	Hrs/wk	СР
echanics III (Hydrostatics, Kinematics, F	Kinetics I) (L1134)	Lecture	3	3
Mechanics III (Hydrostatics, Kinematics, F	Kinetics I) (L1135)	Recitation Section (small)	2	2
lechanics III (Hydrostatics, Kinematics, F	Kinetics I) (L1136)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mathematics I, II, Mechanics I (Statics), Mechanics II	II (Elastostatics)		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in m	nechanical contexts;		
	<ul> <li>explain important steps in model design;</li> </ul>			
	present technical knowledge in stereostatics	S.		
Skills	The students can			
	explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems			their own problems;
	<ul> <li>apply basic hydrostatical, kinematic and kinetic methods to engineering problems;</li> </ul>			
	<ul> <li>estimate the reach and boundaries of statical</li> </ul>	al methods and extend them to be applicable to wider pro	oblem sets.	
Personal Competence				
Social Competence	The students can work in groups and support each	other to overcome difficulties.		
Autonomy	Students are capable of determining their own stren	ngths and weaknesses and to organize their time and lea	ırning 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): C	Core qualification: Compulsory		
Curricula	General Engineering Science (German program, 7	semester): Core qualification: Compulsory		
	Mechanical Engineering: Core qualification: Compu	ulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		

Course L1134: Mechanics III (Hydro	statics, Kinematics, Kinetics I)	
Тур	cture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	Hydrostatics	
	Kinematics  • Kinematics of points and relative motion  • Motion of point systems and rigid bodies  Dynamics  • Terms  • Fundamental equations  • Motion of the rigid body  • Dynamics of gyroscopes	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).	
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3 und 4. 11. Auflage, Springer (2011).	

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



Course L1136: Mechanics III (Hydrostatics, Kinematics, Kinetics I)	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	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 Technic	cal Thermodynamics I		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence	,,	3		
Knowledge	Students are familiar with different cycle processes like Joule, O	otto Diesel Stirling Seiliger and Clausius	Bankine They are ahl	e to derive energetic a
Mowieage	exergetic efficiencies and know the influence different factors. T			
	cooling cycle). They have increased knowledge of steam cycle			
	know the laws of gas mixtures, especially of humid air processe			
	knowledge in gas dynamics and know the definition of the spee			y are provided with ba
	The modge in gae dynamics and mod the deminent of the open	a 0. 00aa aaov aboat a 2avao22		
Skilla	Students are able to use thermodynamic laws for the design of	f to obnical processor. Especially they are	able to formulate and	ray averay and entre
Skills	Students are able to use thermodynamic laws for the design of			
	balances and by this to optimise technical processes. They are		ons in regard to an ou	lllowing gas irom a la
	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 at Students are able to define independently tasks, to get new known		s to find ways to use th	e knowledge in practic
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 qualifica			
Curricula	General Engineering Science (German program, 7 semester): C	Core qualification: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Con			
	General Engineering Science (English program): Core qualifica	tion: Compulsory		
	General Engineering Science (English program, 7 semester): Co	ore qualification: Compulsory		
	Computational Science and Engineering: Specialisation Engine	eering Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			
	Process Engineering: Core qualification: Compulsory			



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 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



Courses		
itle	Typ Hrs/wk CP	
Computer Engineering (L0321) Computer Engineering (L0324)	Lecture         3         4           Recitation Section (small)         1         2	
Module Responsible		
Admission Requirements		
Recommended Previous		
Knowledge		
	The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules:	
	1. Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs, such	that th
	examination's marks are lifted 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, students have reached the following learning results	
Professional Competence		
Knowledge		down
	gates. The module includes the following topics:	
	• Introduction	
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks	
	Sequential logic: Flip-flops, automata, systematic hardware design     Technological foundations	
	<ul> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> </ul>	
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, caches	
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses	
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical compositions are also as a second of the composition of the students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of the composition of	
	computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and	
	components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and	CITCL
	up to complete processors.	
	After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the s	softwa
	executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layer	ers fr
	the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire s	syste
	performance and to propose feasible options.	
Personal Competence		
Personal Competence Social Competence		
Personal Competence Social Competence		
	Students are able to solve similar problems alone or in a group and to present the results accordingly.	
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.	
Social Competence Autonomy Workload in Hours	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.  Independent Study Time 124, Study Time in Lecture 56	
Social Competence Autonomy Workload in Hours Credit points	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.  Independent Study Time 124, Study Time in Lecture 56	
Social Competence Autonomy Workload in Hours Credit points Examination	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.  Independent Study Time 124, Study Time in Lecture 56  6  Written exam	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	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.  Independent Study Time 124, Study Time in Lecture 56  6  Written exam  90 minutes, contents of course and labs	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  6  Written exam  90 minutes, contents of course and labs  General Engineering Science (German program): Core qualification: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	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.  Independent Study Time 124, Study Time in Lecture 56  6  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: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  6  Written exam  90 minutes, contents of course and labs  General Engineering Science (German program): Core qualification: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  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: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  6  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: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  6  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: 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	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  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: 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	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  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: 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	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  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: 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 Biomedical Engineering: Compulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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.  Independent Study Time 124, Study Time in Lecture 56  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: 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	
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Mechatronics: Core qualification: Compulsory

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

Course L0321: Computer Engineeri	ng
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	Introduction Combinational Logic Sequential Logic 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>

Course L0324: Computer Engineerii	ng
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	1. Introduction
	<ul> <li>Principles of digital design</li> <li>Analog versus Digital</li> <li>Gates and flip-flops</li> <li>Aspects of digital design</li> <li>Integrated cicuits</li> <li>Digital devices</li> <li>Time-to-market</li> </ul> 2. Number Systems and Codes
	<ul> <li>General positional number systems</li> <li>Representation of numbers</li> <li>Binary arithmetic</li> <li>Number and character codes</li> <li>Codes for detecting and correcting errors</li> <li>Codes for serial data transmission</li> <li>Binary prefixes</li> </ul>
	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: Mathematic	es 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 Different	tial Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Different		Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Different		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics I + II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in the area of a</li> </ul>	nalysis and differential equations. They	are able to explain	them using appropriate
	examples.	.,,		3 -44 -4
	Students can discuss logical connections between these c	oncepts. They are capable of illustrating t	hese connections w	ith the help of examples.
	They know proof strategies and can reproduce them.			
Skills				
	Students can model problems in the area of analysis and	I differential equations with the help of th	e concepts studied	in this course. Moreover,
	they are capable of solving them by applying established r	nethods.		
	Students are able to discover and verify further logical con	nections between the concepts studied in	the course.	
	<ul> <li>For a given problem, the students can develop and execut</li> </ul>	e a suitable approach, and are able to crit	ically evaluate the re	esults.
Personal Competence				
Social Competence	Out of the second to the secon	http://www.nesthernesth		
	Students are able to work together in teams. They are capa-			
	In doing so, they can communicate new concepts according	ng to the needs of their cooperating parti	iers. Moreover, triey	can design examples to
	check and deepen the understanding of their peers.			
Autonomy	Students are capable of checking their understanding of the control of the c	complex concepts on their own. They can	n specify open ques	tions precisely and know
	where to get help in solving them.			
	Students have developed sufficient persistence to be able	to work for longer periods in a goal-orient	ed manner on hard p	oroblems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points				
Examination	Written exam			
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations 1)			
Assignment for the Following	General Engineering Science (German program): Core qualification	on: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Con			
	Civil- and Environmental Engineering: Core qualification: Compul	sory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): Core qualification	n: Compulsory		
	General Engineering Science (English program, 7 semester): Cor	e qualification: Compulsory		
	Computational Science and Engineering: Core qualification: Com	pulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory			



Course L1028: Analysis III		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	Main features of differential and integrational calculus of several variables	
	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
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1031: Differential Equations 1 (Ordinary Differential Equations)		
Тур	ecture	
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	



ourses				
le		Тур	Hrs/wk	CP
ogramming in C (L0083) ogramming in C (L1488)		Lecture Laboratory Course	1	1
Module Responsible	Prof. Siegfried Rump	Laboratory Godrise	ı	1
Admission Requirements Recommended Previous	None Elementary PC handling skills			
Knowledge	Liententary i o nariding skins			
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have reached the following lear	ning results		
Professional Competence	, 3, 3	3		
Knowledge	The students know by heart the basic syntax of C programming as well	as its meaning, intent and		
	purpose.	3, 11 11		
	They know the fundamental components and principles of elementary	procedural programming		
	based on C programming and can explain them:			
	basic data types (integers, floating point numbers, characters)			
	advanced data types (pointers, arrays, strings, composed data types,	type conversion)		
	• operators (arithmetical operations, logical operations, bit operations)			
	control flow (choice, loops, jumps, conditional compilation)			
	functions and macros			
	important standard libraries and functions			
	• recursion			
	• linked lists			
	The students are prepared for continuing programming lectures like ob-	oject oriented programming in C++.		
Skills	The students know how to use an integrated development environmen	t 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 given C F	Programe		
	osing their knowledge they are able to read and understand given or	rograms.		
	They can solve simple algorithmic problems on their own and can mod	del and program their solutions		
	in C language.			
	The students are able to solve selected exercises from other areas of t	heir study like mathematics,		
	mechanics, electrical engineering or physics with the aid of small C pro			
Personal Competence				
Social Competence	The students are able to work in small teams to solve given weekly tas	ks, to identify and analyze		
	programming errors and to present their results.			
	They are able to explain simple phenomena to each other directly at the	e PC.		
Autonomu	The students proper themselves using the siven teaching metarial an	ed applyed the given		
Autonomy	The students prepare themselves using the given teaching material an programming exercises on their own.	la solve the given		
	programming exercises on their own.			
	Additionally, they write small C programs to understand and check add	dressed issues and also to		
	gain a certain programming experience.			
	For details beyond the scope of the lecture the students inform themse	Ives using the stated		
	literature and / or by supplementary own research.	3		
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 qualification: C			
Curricula	General Engineering Science (German program, 7 semester): Core qu			
	General Engineering Science (English program): Core qualification: C	UITIPUISUTY		



Course L0083: Programming in C	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE/EN
Cycle	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, Weitere Mitarbeiter
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses		
itle	Typ Hrs/wk CP	
ntroduction to Control Systems (L0654) ntroduction to Control Systems (L0655)	Lecture         2         4           Recitation Section (small)         2         2	
Module Responsible		
Admission Requirements		
Recommended Previous		
Knowledge	,	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge		
	Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and can be supported by the second system.	d second ord
	<ul> <li>systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root loops.</li> </ul>	OLIC
	They can explain the dynamics of simple control dops and metipher dynamic properties in terms of nequency response and root for     They can explain the Nyquist stability criterion and the stability margins derived from it.	cus
	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	
<b>-</b>		
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		n solving giv
•	problems.	0 0
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Workload in Hours Credit points		
Credit points Examination	6 Written exam	
Credit points	6 Written exam	
Credit points Examination	6 Written exam 120 min	
Credit points Examination Examination duration and scale	6 Written exam 120 min General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	
Credit points  Examination  Examination duration and scale  Assignment for the Following	6 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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	
Credit points  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	g: Compulsor
Credit points  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	g: Compulso
Credit points  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 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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	g: Compulsor ering Science
Credit points  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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	g: Compulso ering Science
Credit points  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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	g: Compulso ering Science al Engineerin
Credit points  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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory	g: Compulson ering Science al Engineerin
Credit points  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  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica	g: Compulso ering Science al Engineerin
Credit points  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 Mechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science	g: Compulso ering Science al Engineerin
Credit points  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 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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semes	g: Compulson ering Science al Engineerin and Production
Credit points  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 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Sci	g: Compulso ering Science al Engineerin
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Credit points  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 Bloyal 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 Encry 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 Aircraft Systems Engineering General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Enginee Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Meterials in Enginee Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computer Science: Special	g: Compulso ering Science al Engineerin and Production
Credit points  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 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: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: 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 Materials in Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica  Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development at Compulsory  General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Science (Engilish program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory  General Engineering Scienc	g: Compulso ering Science al Engineerin and Production
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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 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	ndependent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	Signals and systems	
	Linear systems, differential equations and transfer functions	
	First and second order systems, poles and zeros, impulse and step response	
	Stability	
	Feedback systems	
	Principle of feedback, open-loop versus closed-loop control	
	Reference tracking and disturbance rejection	
	Types of feedback, PID control	
	System type and steady-state error, error constants	
	Internal model principle	
	Deat legge techniques	
	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  The formula of the first temperature of CVD controllers.	
	Tustin approximation, digital implementation of PID controllers	
	Software tools	
	Introduction to Matlab, Simulink, Control toolbox	
	Computer-based exercises throughout the course	
	Company according to the control of	
Literature	Werner, H., Lecture Notes "Introduction to Control Systems"	
	<ul> <li>Werner, H., Lecture Notes "infloduction to Control Systems</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009</li> </ul>	
	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	Typ Hrs/wk CP		
Structural Analysis I (L0666)	Lecture 2 3		
Structural Analysis I (L0667)	Recitation Section (large) 2 3		
Module Responsible	Prof. Uwe Starossek		
Admission Requirements			
	none		
Recommended Previous	Mechanics I, 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		
Okins	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, they are enabled to self-assess 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): Specialisation Civil- and Environmental Engeneering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory		
	Civil- and Environmental Engineering: Core qualification: Compulsory		
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: 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	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.



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



Module M0613: Reinforced	Concrete I			
module moord. Helliforced	Concrete i			
Courses				
Title		Тур	Hrs/wk	CP
Project Seminar Concrete I (L0896)		Seminar	1	2
Reinforced Concrete Design I (L0303)		Lecture	2	2
Reinforced Concrete Design I (L0305)		Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	none			
Recommended Previous	Basic knowledge in structural analysis and building ma	aterials.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations an safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and distructural members.			
Skills	The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.			
Personal Competence				
Social Competence				
Autonomy	The students are able to carry out simple tasks in the co	onception and dimensioning of structures and to cri	tically reflect the result	S.
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): Spec	cialisation Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 sen	nester): Specialisation Civil Engineering: Compulso	ory	
	Civil- and Environmental Engineering: Core qualification	on: Compulsory		
	General Engineering Science (English program): Spec	ialisation Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 sem			

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



Module M0706: Geotechnic	esl			
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 st	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 stres	sses and deformation in the soils due to weight or in	fluence of structures. T	hey are are able to pro
	the usability (settlements) for shallow foundations.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	General Engineering Science (German program, 7 s	emester): Specialisation Civil Engineering: Compuls	ory	
	Civil- and Environmental Engineering: Core qualifica	tion: Compulsory		
	General Engineering Science (English program): Sp	ecialisation Civil- and Enviromental Engeneering: Co	ompulsory	
	General Engineering Science (English program, 7 se	emester): Specialisation Civil Engineering: Compulso	ory	

Course L0550: Soil Mechanics			
Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Jürgen Grabe		
Language	DE		
Cycle	SoSe		
Content	Structure of the soil Ground surveying Compstition and properties of the soil Groundwater One-dimensional compression Spreading of stresses Settlement calculation Consolidation Shear strength Earth pressure Slope failure Ground failure Suspension based earth tenches		
Literature	<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	ourse 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		



ourses				
tle		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 sys	tems. Good knowledge in maths as covere	d by the moduls Mat	hematik 1-3 is evner
	Further experience with spectral transformations (Fourier serie			
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and line			
	to apply the fundamental transformations of continuous-time a			
	and systems mathematically in both time and image domain		in time domain and i	mage domain which
	caused by the transition of a continuous-time signal to a discre			
Skills	The students are able to describe and analyse deterministic s	•	-	
	can analyse and design basic systems regarding important pr		ponse, stability, linear	rity etc They can as
Davidanal Commissioner	the impact of LTI systems on the signal properties in time and f	requency domain.		
Personal Competence	The state of the s			
Social Competence	The students are able to acquire relevant information from a	porapriata literatura sources Theorem	rol their level of look	rladge during the le
Autonomy	The students are able to acquire relevant information from approved by solving tutorial problems, software tools, clicker systems.		IOI ITIEIT IEVEI OF KNOW	neage during the le
Warkland in Harris	period by solving tutorial problems, software tools, clicker syste	5111.		
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			
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 General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester):		ulsory	
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	General Engineering Science (German program, 7 semester):			
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	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semest			
	Compulsory	, ,		0 0
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering, Foo	cus Mechatronics: Cor	mpulsory
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engineering	, Focus Theoretical M	Mechanical Enginee
	Compulsory	5 - 3		0
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	n Civil- and Enviromental Engeneering: Cor	mpulsory	
	General Engineering Science (English program): Specialisation	n Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	n Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
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	General Engineering Science (English program, 7 semester):		-	
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	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester).			
	Compulsory		,, , , , , , , , , , , , , , , , , , ,	gcoming cole
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering Foo	us Mechatronics: Con	npulsory
	General Engineering Science (English program, 7 semester).			
		,		
	Compulsory			
	Computational Science and Engineering: Core qualification: C	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 DE/EN		
Language			
Content	Basic classification and description of continuous-time and discrete-time signals and systems		
	Concvolution		
	Power and energy of signals		
	Correlation functions of deterministic signals		
	Linear time-invariant (LTI) systems		
	Signal transformations:		
	Fourier-Series		
	Fourier Transform		
	Laplace Transform		
	Discrete-time Fourier Transform		
	Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)		
	Z-Transform		
	Analysis and design of LTI systems in time and frequency domain		
	Basic filter types		
	Sampling, sampling 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	pendent Study Time 46, Study Time in Lecture 14	
Lecturer	Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0744: Structural	Analysis II			
module mor44. Otractarar	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	Manharita III			
Knowledge	Mechanics I/II			
	Mathematics I/II			
	Differential Equations I			
	Structural Analysis I			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
<b>Professional Competence</b>				
Knowledge	After successful completion of this module, students can expres	s the basic aspects of linear frame analysis	of statically indetermi	nate systems.
Skills	After successful completion of this module, the students are able	e to analyze state variables and to construc	t influence lines of sta	tically inderminate plane
	and spatial frame and truss structures.			
Personal Competence				
Social Competence				
Autonomy	The students are able to work in-term homework assignments	s. Due to the in-term feedback, they are e	nabled to self-assess	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): Specialisation	n Civil- and Environmental Engangering: Co	mnulsory	
Assignment for the Following Curricula				
Curricula	General Engineering Science (German program, 7 semester): S		У	
	Civil- and Environmental Engineering: Core qualification: Comp			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): S	pecialisation Civil Engineering: Compulsor	у	

Course L0673: 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	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	ependent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



courses				
itle		Тур	Hrs/wk	CP
troduction 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	<b>9</b>			
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of man Marketing and Innovation, and also to Investment and Controlling. In		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management	and 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 Manageme			
	describe and explain basic business functions as production  rescource management information management inpovation		chain management,	organization and hum
	ressource management, information management, innovation  explain the relevance of planning and decision making in E		ultiple objectives and	uncertainty and expla
	some basic methods from mathematical Finance	domode, dop. in chadaone ander me	pro objectives and	anconanty, and oxpin
	state basics from accounting and costing and selected control	ling methods.		
Skills	Students are able to analyse business units with respect to c Entrepreneurship project in a team. In particular, they are able to	ifferent criteria (organization, objection)	ctives, strategies etc	) and to carry out
	analyse Management goals and structure them appropriately			
	<ul> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives,</li> </ul>	under uncertainty and under risk		
	<ul> <li>analyse production and procurement systems and Business in</li> </ul>			
	analyse and apply basic methods of marketing			
	select and apply basic methods from mathematical finance to	predefined problems		
	apply basic methods from accounting, costing and controlling	to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	daf.ill.in a kanna af ak.ida.ak			
	<ul> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneursl</li> </ul>	in project and write a coherent repor	t on the project	
	to communicate appropriately and	inp project and write a concrenit repor	ton 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.			
Westlerd's Herry	Indicated Ot de True 440 Ot de True in Land on 70			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points  Examination	6 Written exam			
Examination duration and scale				
Assignment for the Following	90 Minuten  General Engineering Science (German program): Specialisation Elec	trical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Con			
	General Engineering Science (German program): Specialisation Program			
	General Engineering Science (German program): Specialisation Biop	rocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Ene	rgy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program): Specialisation Civi		mpulsory	
	General Engineering Science (German program): Specialisation Med			
	General Engineering Science (German program): Specialisation Bior			
	General Engineering Science (German program): Specialisation Nav General Engineering Science (German program, 7 semester): Specia		uleon	
	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	lisation Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): Specia	lisation Civil Engineering: Compulso	ry	
	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	ecialisation Mechanical Engineering	g, Focus Materials ir	Engineering Science
	Compulsory  General Engineering Science (German program, 7 semester): Spr	cialisation Machanical Engineering	Facus Theoretical N	Analogated Factors



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



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

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
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 Building Materials and Building F	Physics		
module mosou. I fillelples	or building materials and building i	Trysics		
Courses				
Title		Тур	Hrs/wk	СР
Building Physics (L0217)		Lecture	2	2
Building Physics (L0219)		Recitation Section (large)	1	1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materials (L0215)		Lecture	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Knowledge of physics, chemistry and mathema	atics from school		
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describ the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion process and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.			
Skills	The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.			
Personal Competence				
Social Competence	The students are able to support each other to I	learn the very extensive specialist knowledge.		
Autonomy	The students are able to make the timing and the	he operation steps to learn the specialist knowledge of a ver	ry extensive field.	
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 stündige Klausur			
Assignment for the Following	General Engineering Science (German program	m): Specialisation Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula		m, 7 semester): Specialisation Civil Engineering: Compulso		
	Civil- and Environmental Engineering: Core qu			
		n): Specialisation Civil- and Enviromental Engeneering: Co	mpulsory	
		n, 7 semester): Specialisation Civil Engineering: Compulsor		
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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 Struct	tures I			
Courses				
Title		Тур	Hrs/wk	CP
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Dr. Jürgen Priebe			
Admission Requirements	none			
Recommended Previous	Structural analysis I, Structural analysis II			
Knowledge	Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	Principles of Building Materials and Building Physics			
	Timopies of building waterials and building Friysics			
Educational Objectives	After taking part successfully, students have reached the following	g 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,	compression and bending		
Skills	Students can rate and apply the material steel appropiately with respect to its properties and usage.			
	They can use the security concept with respect to loads, forces ar	nd resistances.		
	They can check the ultimate limit state and the serviceability of sir	nple members in tension, compression an	d bending.	
Personal Competence				
Social Competence	After participation of an optional course (building of a simple tru	ss) they are able to organize themselves	in groups. They will	be successful in guided
·	building a truss with bolted connections according to design draw	rings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation	Civil- and Enviromental Engeneering: Cor	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Civil Engineering: Compulsor	ry	
	Civil- and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation (	Civil- and Enviromental Engeneering: Con	npulsory	
	General Engineering Science (English program, 7 semester): Spe	ecialisation Civil Engineering: Compulsory	/	

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	Dr. Jürgen Priebe, Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction to steel constructions</li> <li>Materials</li> <li>Design and security model</li> <li>Tension rods</li> <li>Beams (elsatic and plastic design</li> <li>Column design</li> <li>Bolted connections</li> </ul>
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	Dr. Jürgen Priebe	
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.	ate limit state (shear, bending, to	rsion) and in the servi	ceability limit state (crack
	<ul> <li>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.).</li> </ul>			
	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 an analysis and an anyon and an 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	s 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			
		0 0 111	· ·	

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
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Literature	<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> <li>Vorlesungsumdrucke</li> <li>König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998</li> <li>Zilich 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	
CP	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	



of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills  The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.			
Title Hydrology (L0909) Hydrology (L0956) Hydromechanics (L0615) Hydromechanics (L0616)  Module Responsible   Prof. Peter Fröhle   Admission Requirements   none   Recommended Previous   Mathematics I, II and III   Educational Objectives   After taking part successfully, students have reached the following learn of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills   The students are able to apply the fundamental formulations of hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence   The students are able to prepare and present technical presentations for the strategy on an individual basis.  Workload in Hours   Independent Study Time 110, Study Time in Lecture 70   Credit points   6			
Hydrology (L0999) Hydrology (L0956) Hydromechanics (L0615) Hydromechanics (L0616)  Module Responsible Prof. Peter Fröhle Admission Requirements none Recommended Previous Knowledge Mechanik I und II  Educational Objectives After taking part successfully, students have reached the following learn Professional Competence Knowledge The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-rithe determination of a unit-hydrograph.  Skills The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6	Тур	Hrs/wk	CP
Hydrology (L0956) Hydromechanics (L0615) Hydromechanics (L0615) Hydromechanics (L0615)  Module Responsible 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 following learn Professional Competence Knowledge The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills The students are able to apply the fundamental formulations of hydron hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field — measurements of hydrological analyze and assess respective measurements.  Personal Competence Social Competence The students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for the students are able to prepare the students are able to prepare the studen	Lecture	1	1
Hydromechanics (L0615) Hydromechanics (L0616)  Module Responsible	Problem-based Learning	1	2
Module Responsible   Prof. Peter Fröhle   Admission Requirements   none   Recommended Previous   Mathematics I, II and III   Mechanik I und II    Educational Objectives   After taking part successfully, students have reached the following learn   Professional Competence   Knowledge   The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills   The students are able to apply the fundamental formulations of hydron hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field — measurements of hydrological analyze and assess respective measurements.  Personal Competence   The students are able to prepare and present technical presentations for the students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours   Independent Study Time 110, Study Time in Lecture 70   Credit points   6	Lecture	2	2
Admission Requirements Recommended Previous Knowledge Mathematics I, II and III Mechanik I und II  Educational Objectives Professional Competence Knowledge The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills The students are able to apply the fundamental formulations of hydron hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field — measurements of hydrological analyze and assess respective measurements.  Personal Competence Social Competence The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6	Recitation Section (large)	1	1
Recommended Previous Knowledge  Mathematics I, II and III  Mechanik I und II  Educational Objectives  After taking part successfully, students have reached the following learn  Professional Competence Knowledge  The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills  The students are able to apply the fundamental formulations of hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence  Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6			
Educational Objectives After taking part successfully, students have reached the following learn Professional Competence  Knowledge The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field — measurements of hydrological analyze and assess respective measurements.  Personal Competence Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6			
Educational Objectives After taking part successfully, students have reached the following learn Professional Competence  Knowledge The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field — measurements of hydrological analyze and assess respective measurements.  Personal Competence Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6			
Professional Competence  Knowledge  The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills  Skills  The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence  Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6			
The students are able to define the basic terms of hydromechanics and of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills  Skills  The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence  Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6	ning results		
of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and Besides, the students can describe the main aspects of rainfall-run-off-the determination of a unit-hydrograph.  Skills  The students are able to apply the fundamental formulations of hydror hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence  Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6			
hydrological approaches and methods to simple hydrological problem models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological analyze and assess respective measurements.  Personal Competence  Social Competence  The students are able to prepare and present technical presentations for strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6	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.		
Social Competence  The students are able to prepare and present technical presentations for Students can provide each other with feedback and suggestions on strategy on an individual basis.  Workload in Hours  Independent Study Time 110, Study Time in Lecture 70  Credit points  6	hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storag 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		
Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6	or given topics in groups.		
Credit points 6	their results. They are capable of	reflecting their study	techniques and learning
•			
Examination Written exam			
Examination duration and scale The duration of the examination is 2 hours. The examination include calculations tasks.	les tasks with respect to the gene	ral understanding of	the lecture contents and
Assignment for the Following General Engineering Science (German program): Specialisation Civil-	and Environmental Engeneering: Co	ompulsory	
Curricula General Engineering Science (German program, 7 semester): Specialis			
Civil- and Environmental Engineering: Core qualification: Compulsory			
General Engineering Science (English program): Specialisation Civil- a	and Enviromental Engeneering: Co	mpulsory	
General Engineering Science (English program, 7 semester): Specialis			

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	
Content	See interlocking course	
Literature	See interlocking course	

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
Literature	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 M0755: Geotechnic	es II			
Courses				
Title		Тур	Hrs/wk	CP
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	- Markey Land III			
	Mechanics I-II     Outside the I			
	Geotechnics I			
Educational Objectives	After taking part successfully, students have reached the following 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:			
	and the state of t	all and		
	<ul> <li>verificate the stability and usability of foundations,</li> <li>know individual methods of ground improvement and apply them in their range of application,</li> </ul>			
		ement and apply them in their range of application,		
	design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture	84		
Credit points	* * * * * * * * * * * * * * * * * * * *			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program):	Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula		semester): Specialisation Civil Engineering: Elective		
	Civil- and Environmental Engineering: Core qualifi		· ·	
		Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
	General Engineering Science (English program, 7			

Course L0552: Foundation Engineer	ing	
Тур	ecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
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
СР	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 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 the state 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	uctures. They can present the derivation	on and detailed ex	planation of important
	standards for the design of drinking water supply and wastewater dispo			
	empiricals assumptions and scientific simplifcations. 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	ney can acquire ar	ppropriate knowledae
,	when being given some clues or information with regard to the approach to	•		
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	For the second s		
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	Environmental Engancering Committee	NEW COLUMN	
	General Engineering Science (English program): Specialisation Civil- and		•	
	General Engineering Science (English program, 7 semester): Specialisatio	in Civil Engineering: Elective Compuls	ury	



Course L0276: Wastewater Disposa	ıl
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
	<ul> <li>Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)</li> <li>Biological Treatment (aerobic, anaerobic, anoxic)</li> <li>Special Wastewater Treatment Processes (Ozonation, Adsorption)</li> </ul>
Literature	Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.
	The literature listed below is available in the library of the TUHH.
	<ul> <li>Taschenbuch der Stadtentwässerung: mit 10 Tafeln und 67 Tabellen, Imhoff, K., &amp; . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl.</li> <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.). Renningen: expert-Verl.</li> <li>Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering: design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.</li> <li>Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>

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



Module M0869: Hydraulic E	ingineering II			
Courses				
Title		Тур	Hrs/wk	CP
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 follow	ing learning results		
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engi	neering and hydraulics. They are able to e	xplain the applicatio	n of basic hydrodynamic
	formulations (conservation laws) to practical hydraulic engin	eering problems. Besides this, the studen	ts can illustrate imp	ortant tasks of hydraulic
	engineering and give an overview over river engineering, flood	protection, hydraulic power engineering an	d waterways engine	ering.
Skills	The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering			
	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 flow cond	ditions of pipe system.		
Personal Competence				
Social Competence				
Autonomy				
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	n includes tasks with respect to the genera	al understanding of	the lecture contents and
	calculations tasks.			
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: Elective Co	ompulsory	
	Civil- and Environmental Engineering: Core qualification: Com	pulsory	•	
	General Engineering Science (English program): Specialisation	•	npulsory	
	General Engineering Science (English program, 7 semester): S	Specialisation Civil Engineering: Elective Co	mpulsory	
			· ,	

Course L0957: Hydraulics	
•	Lecture
Hrs/wk	
CP	
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Peter Fröhle
Language	
Cycle	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	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>	
iterature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006	
Literature	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



## **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.

Module M0598: Mechanical Engineering: Design				
Module Mosso: Mechanica	i Engineering: Design			
Courses				
Title		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)  Team Project Design Methodology (L026)	7)	Practical Course Problem-based Learning	3	2
Module Responsible	Prof. Dieter Krause	Troblem based Learning	2	'
Admission Requirements	None			
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanics			
	Fundamentals of Materials Science     Production Forcionaries			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain design guidelines for machinery parts e.g. consider	ing load situation, materials and manuf	acturing requirements	i,
	describe basics of 3D CAD,			
	<ul> <li>explain basics methods of engineering designing.</li> </ul>			
Skills	After passing the module, students are able to:			
Citing	Their passing the module, stadents are able to.			
	independently create sketches, technical drawings and doc	umentations e.g. using 3D CAD,		
	design components based on design guidelines autonomore	usly,		
	dimension (calculate) used components,			
	use methods to design and solve engineering design tasks	systamtically and solution-oriented,		
	apply creativity techniques in teams.			
Personal Competence				
Social Competence	After passing the module, students are able to:			
	<ul> <li>develop and evaluate solutions in groups including making</li> </ul>	and documenting decisions		
	moderate the use of scientific methods,	and documenting documents,		
	<ul> <li>present and discuss solutions and technical drawings within</li> </ul>	n groups,		
	reflect the own results in the work groups of the course.			
Autonomy	Students are able			
Autonomy	Students are able			
	to estimate their level of knowledge using activating metho	ds within the lectures (e.g. with clickers	),	
	To solve engineering design tasks systematically.			
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): Specialisation E	nergy and Enviromental Engineering: C	Compulsory	
Curricula	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program): Specialisation Bi			
	General Engineering Science (German program, 7 semester): Spec	ů ů	, ,	
	General Engineering Science (German program, 7 semester): Spec General Engineering Science (German program, 7 semester): Spec			n/
	Energy and Environmental Engineering: Core qualification: Compu		igineering. Compuiso	y
	General Engineering Science (English program): Specialisation Er	•	ompulsory	
	General Engineering Science (English program): Specialisation Me		E	
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program, 7 semester): Spec		mpulsory	
	General Engineering Science (English program, 7 semester): Spec	ialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester): Spec	ialisation Energy and Enviromental En	gineering: Compulsor	у
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



Course L0268: Embodiment Design and 3D-CAD		
Тур	Lecture	
Hrs/wk	2	
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
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	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	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 M0957: Introduction	n into Energy and Environmental Engine	ering		
Courses				
		Tun	Hrs/wk	CP
Title Introduction to Energy and Environmental Engineering (L0212)		Typ Problem-based Learning		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	• •	•	e dimension of their future
	responsibility and know about the necessity to find comp	romises between energy usage and envir	ronment protection.	
	Through a practical course in physics the students learn	to deliver an overview of specialist aspect	ts of physics.	
Skills	The students master the fundamentals of technical comments		alized topics orally. By con	nparing analysis of literature
	sources, students are able to work scientifically to critical	ly discuss them on a basic level.		
	The students are able to communicate their deepened p	hysics knowledge in ways of written techn	ical communication.	
Personal Competence				
Social Competence	The social skills of the students within the group but also	with the visited Company are strengthene	ed. For the preparation of the	he Seminar presentation the
	students learn communication.			
	The practical course in Physics is also carried out in g	roups, including the preparation of the te	st reports. The students st	rengthen 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 th	e 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 individually	r prepare and present a sho	ort 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 sen	ninar; 6 Experiments with:	introd. seminar (20 min), 4
	handwritten pages preparatory script, transcript on their	own and attestation; 10min short talk; 1 p.	handout	
Assignment for the Following	General Engineering Science (German program): Speci	alisation Energy and Enviromental Engine	ering: Compulsory	
Curricula	Energy and Environmental Engineering: Core qualification		•	
	General Engineering Science (English program): Specia	lisation Energy and Enviromental Engine	ering: Compulsory	
			· · · · · ·	

Course L0212: Introduction to Energ	gy and Environmental Engineering
	Problem-based Learning
Hrs/wk	4
СР	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 invieted 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 • Power plant components (boiler, steam turbine, condenser, feed water heaters, etc.) • Distributed electricity generation and energy supply • District and neighbourhood heating networks • Renewable energy • Energy storage • Electric grids
Litaratura	Energy management at end-user level     Energy-intensive industries     Environmental technology (e.g., wastewater treatment plants)  Keine erforderlich
Literature	Refine entition



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.



	als of Fluid Mechanics			
Courses				
Title		Tun	Hrs/wk	CP
undamentals of Fluid Mechanics (L0091)		<b>Typ</b> Lecture	7 nrs/wk	4
luid Mechanics for Process Engineering (		Recitation Section (large)	2	2
	Prof. Michael Schlüter			
·	None			
Recommended Previous	140110			
Knowledge	Mathematics I+II+III			
	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	Simplification and solving of partial differential	al equations		
	<ul> <li>Integration</li> </ul>			
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence		· · · · · · · · · · · · · · · · · · ·		
Knowledge	Students are able to:			
-				
	explain the difference between different types			
		the Reynolds Transport-Theorem in process engine		
	explain simplifications of the Continuity- and it	Navier-Stokes-Equation by using physical boundar	y conditions	
Skills	The students are able to			
	describes and an electronic constitute flavores.	other and the His		
	describe and model incompressible flows ma			
	* * '	nanics by simplifications to archive quantitative solu	lions e.g. by integration	
	<ul> <li>notice the dependency between theory and te</li> <li>use the learned basics for fluid dynamical app</li> </ul>			
	use the learned basics for fluid dyffamical app	plications in fields of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from cubics	ct related, professional publications and relate that i	information to the conto	et of the leature and
		s in small groups. They are able to present their res		
	exercises)	s in small groups. They are able to present their res	idits ellectively ill Eligils	ir (e.g. daring sinaii gi
	,	y themselves, to discuss the solutions orally and to	present the results.	
		,	,	
Autonomy	The students are able to			
	search further literature for each topic and to a	expand their knowledge with this literature.		
		valuate 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): Sp	pecialisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Sp	pecialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Sp	pecialisation Energy and Enviromental Engineering	: Compulsory	
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, 7 s	, ,	Engineering: Compulso	ry
	Bioprocess Engineering: Core qualification: Compuls	,		
	Energy and Environmental Engineering: Core qualifi			
	General Engineering Science (English program): Sp.		Compulsor	
	General Engineering Science (English program): Sp.	0, 0	Compulsory	
	General Engineering Science (English program): Sp	ecialisation Frocess Engineering: Compulsory		
		amostor): Specialization Process Facility of	nulcory	
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	emester): Specialisation Bioprocess Engineering: C	Compulsory	ov.
	General Engineering Science (English program, 7 se	emester): Specialisation Bioprocess Engineering: C emester): Specialisation Energy and Enviromental I	Compulsory	у



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



Module M0610: Electrical M	lachines			
Courses				
Title		Тур	Hrs/wk	CP
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals,	differentials		
Knowledge	Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principles of electric a	nd magnetic fields.		
	They can describe the function of the standard types of electric	machines and present the correspon	nding equations and o	paracteristic curves. For
	typically used drives they can explain the major parameters of the	·		
	typically used unives they can explain the major parameters of the	shergy emiciency of the whole system i	ioni the power grid to the	e driveri erigirie.
Skills	Students arw able to calculate two-dimensional electric and magn	etic fields in particular ferromagnetic c	ircuits with air gap. For	his they apply the usua
	methods of the design auf electric machines.			
	They can calulate the operational performance of electric machine	e from their given characteristic data a	nd calacted quantities a	nd characteristic curves
	They apply the usual equivalent circuits and graphical methods.	s nom their given characteristic data a	na serectea quantities a	na characteristic curves
	They apply the assar equivalent chedits and graphical methods.			
Barramal Campustance				
Personal Competence				
Social Competence				
Autonomy	Students are able independently to calculate electric and magn	**		
	performance of electric machines from the charactersitic data and t	neycan calculate thereof selected qua	nuiles 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 E	noray and Environmental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation B	• •		
Gurricula	General Engineering Science (German program, 7 semester): Spe		•	,
	General Engineering Science (German program, 7 semester): Spe	**		,
	Electrical Engineering: Core qualification: Elective Compulsory	o.aoaso.i moonamoar Engineening. E	out outipationy	
	Energy and Environmental Engineering: Core qualification: Compa	ılsorv		
	General Engineering Science (English program): Specialisation En		Compulsory	
	General Engineering Science (English program): Specialisation M			
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec			
	Computational Science and Engineering: Specialisation Engineer			
	Logistics and Mobility: Specialisation Engineering Science: Electiv			
	Mechanical Engineering: Core qualification: Elective Compulsory	. ,		
	Mechatronics: Core qualification: Compulsory			



Course L0293: Electrical Machines	
Тур	Lecture
Hrs/wk	3
СР	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 black as being of			
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
СР	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
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
Content	Energy: development and significance Fundamentals and basic concepts  Energy demand and future trends (heat, electricity, fuels)  Energy reserve and sources  Cost and efficiency calculation  Final and effective energy from petroleum, natural gas, coal, uranium and other  Legal, administrative and organizational aspects of energy systems  Energy systems as a permanent optimization task
Literature	Kopien der Folien

Course L0313: 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		
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>	



Module M0829: Foundation	
Courses	
Title	Typ Hrs/wk CP
Introduction to Management (L0880)	Lecture 3 3  Problem-based Learning 2 3
Project Entrepreneurship (L0882)  Module Responsible	Problem-based Learning 2 3  Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	basic Mowiedge of Mathematics and business
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	<ul> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from field of Management</li> </ul>
	<ul> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and hum ressource management, information management, innovation management and marketing</li> </ul>
	<ul> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and expl. some basic methods from mathematical Finance</li> </ul>
	state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk     applying production and programment systems and Rusiness information systems.
	<ul> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> </ul>
	select and apply basic methods from mathematical finance to predefined problems
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
coolai compotento	
	work successfully in a team of students
	to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	to communicate appropriately and
	to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	work in a team and to organize the team themselves
	to write a report on their project.
	to time 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	
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
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory  General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Givin- and Environmental 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: 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: Compulso 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

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

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         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 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		
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.		



odule M0538: Heat and N	Mass Transfer			
ourses		Tim	Unatude	CD.
le at and Mass Transfer (L0101)		Typ Lecture	Hrs/wk	<b>CP</b> 4
at and Mass Transfer (L0102)		Recitation Section (small)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge				
	The students are capable of explaining qualitative and the students are capable.	d determining quantitative heat transfer if	i procedural apparatu	s (e. g. heat exchar
	chemical reactors).  • They are capable of distinguish and characterize differ	ont kinds of hoat transfer machanisms nan	noly host conduction. I	and transfor and the
	<ul> <li>They are capable of distinguish and characterize differ radiation.</li> </ul>	ent kinds of fleat transfer flechamsins flan	lely fleat conduction, i	leat transier and the
	The students have the ability to explain the physical ba	sis for mass transfer in detail and to descri	he mass transfer quali	tative and quantitativ
	using suitable mass transfer theories.	or mass ranser in detail and is describ	se mass nansier quan	and quantitativ
	They are able to depict the analogy between heat- and	mass transfer and to describe complex link	ed processes in detail	
	, , , , ,	·	•	
Skills	The students are able to set reasonable system boun-	daries for a given transport problem by us	sing the gained knowle	edge and to balance
	corresponding energy and mass flow, respectively.		3 3	
	They are capable to solve specific heat transfer problem.	ems (e.g. heated chemical reactors, tempe	erature alteration in flu	ids) and to calculate
	corresponding heat flows.			
	Using dimensionless quantities, the students can execu-	te scaling up of technical processes or app	paratus.	
	They are able to distinguish between diffusion, conver-	ctive mass transition and mass transfer. The	ney can use this know	ledge for the descrip
	and design of apparatus (e.g. extraction column, rectific	ation column).		
	In this context, the students are capable to choose	and design fundamental types of heat a	nd mass exchanger f	or a specific applica
	considering their advantages and disadvantages, respe	ectively.		
	In addition, they can calculate both, steady-state and no	n-steady-state processes in procedural ap	paratus.	
	The students are capable to connect their knowledge	e obtained in this course with knowleg	de of other courses (	n particular the cou
	thermodynamics, fluid mechanics and chemical proces	s engineering) to solve concrete technical p	problems.	
Personal Competence				
Social Competence	The students are capable to work on subject-specific c	hallenges in teams and to present the resu	ults orally in a reasona	ble manner to tutors
	other students.	,	,	
Autonomy				
	The students are able to find and evaluate necessary in	formation from suitable sources		
	They are able to prove their level of knowledge du	ring the course with accompanying proc	edure continuously (	clicker-system, exam
	assignments) and on this basis they can control their le	arning processes.		
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42			
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	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: 0	Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Energy and Enviromental Er	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	mpulsory		
	General Engineering Science (English program): Specialisatio	n Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisatio	n Energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (English program): Specialisatio			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):		gineering: Compulsor	/
	Technomathematics: Specialisation III. Engineering Science: E	lective Compulsory		
		, , , , , , , , , , , , , , , , , , , ,		
	Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory	,		



Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, 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	ster
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	4 Hallande
	Heat transfer
	<ul> <li>Introduction, one-dimensional heat conduction</li> <li>Convective heat transfer</li> </ul>
	Multidimensional heat conduction
	Non-steady heat conduction
	Thermal radiation
	2. Mass transfer
	one-way diffusion, equimolar countercurrent diffusion
	<ul> <li>boundary layer theory, non-steady mass transfer</li> </ul>
	Heat and mass transfer single particle/ fixed bed
	Mass transfer and chemical reactions
	The students work on tasks in small groups and present their results in front of all students.
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer
	2. VDI-Wärmeatlas



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
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	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3		
Knowledge				
	The students can distinguish and describe different types o The students develop an understanding for the course of process, the possibilities of energy saving, and the selectio They have good knowledge of designing methods for sepa	concentration during a separation proce on of separation systems		
Skills	Using the gained knowledge the students can select a reasenergy and material balances The students can use different graphical methods for the dear they can select and design a basic type of thermal sepanoreess The students are capable to obtain independently the need They can calculate continuous and discontinuous processe The students are able to prove their theoretical knowledge The students are able to discuss the theoretical background the students are capable of linking their gained knowledge with the Other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical the students are capable of linking their gained knowledge with the other lectures such as the students are capable to the students are capa	esigning of a separation process and defi aration process for a given case based of ded material properties from appropriate s es in the experimental lab work. d and the content of the experimental wo the content of other lectures and use it to	ne the amount of the on the advantages a sources (diagrams and	oretical stages required and disadvantages of the disadvantages of the disadvantages of the disadvantages.
Personal Competence Social Competence	The students can work technical assignments in small grou  The students are able to carry out practical lab work in sm			n them. They are able to
	discuss their results and to document them scientifically in			· · · · · · · · · · · · · · · · · · ·
		·		
Autonomy	The students are capable to obtain the needed information The students can proof the state of their knowledge with ex	•	, ,	ing process
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
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	Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program): Specialisation E		ompulsory	
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (German program, 7 semiester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Spe			у
	Bioprocess Engineering: Core qualification: Compulsory	and the second s	,	,
	Energy and Environmental Engineering: Core qualification: Comp	ulsorv		
	General Engineering Science (English program): Specialisation B	*		
	General Engineering Science (English program): Specialisation E		mnulsory	
			призоту	
	General Engineering Science (English program): Specialisation Pl		conv	
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spec	olansation Energy and Enviromental Eng	meening: Compulsor)	1
	Process Engineering: Core qualification: Compulsory			



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	<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. 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	1 Processes
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE 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
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Course L1159: Separation Processe	98			
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     Designing			
	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 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 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 place 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): Specialisat				
	General Engineering Science (German program): Specialisat				
	General Engineering Science (German program). Specialisation Frocess 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 Biomedical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester)				
	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 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				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
	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				



Hrswk 2  CP 2  Workload in Hours Lacturer Laciturer Laciturer Laciturer Cycle  Wise/SoSe  Content  Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different ga automotive exhaust are used.  Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will 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 application interferometer and optical fibers demonstrated.  Experiment 4: Michelson of the parameters of a control system and optimal control parameters  Literature  Versuch 1:  Literature  Versuch 1:  Literature  Literature  Literature  Literature  Literature  Literature  Versuch 1:  Literature  Literature  Versuch 2:  Literature  Literature  Versuch 3:  Literature  Versuch 4:  Literature  Literature  Versuch 3:  Literature  Literature  Versuch 4:  Literature  Versuch 4:  Literature  Literature  Versuch 4:  Literature  Versuch 4:  Literature  Versuch 5:  Literature  Versuch 6:  Literature  Versuch 7:  Literature  Versuch 8:  Literature  Versuch 8:  Literature  Versuch 9:  Versuch 9:  Versuch 9:  Versuch 9:  Literature  Literature  Versuch 9:  Versuch 9:  Versuch 9:  Literature  Literature  Versuch 9:  Versuch 9:  Versuch 4:  Literature  Literature  Literature  Versuch 9:  Versuch 9:  Versuch 9:  Literature  Literature  Literature  Literature  Literature  Versuch 9:  Versuch 9:  Literature  Literature  Literature  Literature  Versuch 9:  Literature  Literature  Literature  Literature  Versuch 9:  Literature  Litera		Course L1119: Practical Course: Mea
Workload in Hours   Independent Study Time 32, Study Time in Lecture 28		
Workload in Hours Lecturer Language DE Cycle Wise/SoSe Content Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different ga automotive exhaust are used. Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will to 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 application interferometer and optical fibers demonstrated. Experiment 4:identification of the parameters of a control system and optimal control parameters  Literature Versuch 1:  Literature  Versuch 1:  Literature  Versuch 1:  Literature  Versuch 3:  Literature  Versuch 4:  Circle Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Auf Verfagegesellschaft, Stuttgart, 1974  Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur Wien, 1979  Littreferber 4:  Circle Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Auf Verfaugegesellschaft, Stuttgart, 1974  Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur Wien, 1979  Littreferber 4:  Circle Analyse der Luft, Band 5: VDI-Richtlinien 2450 Bi.1, 2451 Bi.4, 2453 Bi.5, 2455 Bi.1  Versuch 2:  Circle Gebrauchs- und Bedienungsanweisungen  VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bi.1, 2451 Bi.4, 2453 Bi.5, 2455 Bi.1  Versuch 3:  Literature  Versuch 3:  Literature  Versuch 3:  Literature  Versuch 4:  Versuch 4:		
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Literature  Versuch 1:  Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl Verlagsgesellschaft, Stuttgart, 1974  Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur Wien, 1979  Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung e 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:	d applications with Michelson	
<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Auf Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur 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> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <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>		E
Verlagsgesellschaft, Stuttgart, 1974  Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur Wien, 1979  Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen  VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1  Versuch 2:  Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze  Versuch 3:  Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989  Versuch 4:		Literature \
<ul> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <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> <li>Versuch 4:</li> </ul>	R. Oldenburg Verlag, Müncher	
<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> <li>Versuch 4:</li> </ul>		V
<ul> <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> <li>Versuch 4:</li> </ul>		V
<ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> </ul>		V
Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen		



Course L1116: Measurement Techn	ology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	2
CP	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



Module M0639: Gas and St	eam Power Plants			
Courses				
Gas and Steam Power Plants (L0206)		Typ Lecture	Hrs/wk	<b>CP</b> 4
Gas and Steam Power Plants (L0210)	In the state of	Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous	"Technical Thermodynamics I and II"			
Knowledge	"Heat Transfer"			
	"Fluid Mechanics"			
Edward Obligation	Affactal Second of the state of	- de la contra del la		
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence	The state of the s	de considerada de la constanta	the authorized account	land dans the discount
Knowledge	The students can evaluate the development of the electricity			
	types of power plant and the layout of the steam generator describe the exhaust gas cleaning apparatus and other er			
	fossil-fuelled power plants and regenerative (solar, wind) po			Salbilities of convention
	The students can on a basic level explain principles, opera acidification, fine particulate or CO <sub>2</sub> emissions and the resu			
	from interconnecting conventional power plants and renew			
	supply and network stability, also with economics considered			· · · · · · · · · · · · · · · · · · ·
Skills	The students are able, using theories and methods of the energy technology from fossil fuels and based on deep knowledge on the function construction of gas and steam power plants, to identify basic associations in the production of heat and electricity, so as to develop concessolutions. Through analysis of the problem and exposure to the inherent interconnections between heat and power generation, the students endowed with the capability and methodology to develop realistic optimal concepts for the environmentally benign generation of electricity approduction of heat. From the technical basics the students become the ability to follow better the deliberations on the electricity mix composition the energy-political triangle (economy, secure supply and environmental protection).		to develop conception tion, the students will be tion of electricity and the	
	The students are able to highlight aspects of the design	n and development of power plant cycles v	vith the specialised	software suite EBSILO
	Professional TM and to independently program simplified pov	ver plant process simulations.		
	The students are able to do simplified calculations of turbo m		dual stages.	
Personal Competence				
Social Competence	The students are able to solve subject-specific exercises in a	smalls groups and can present their common r	esults orally.	
	The students are able to analyze suitable technical alterna support the energy revolution effectively.			ineering activities and
Autonomy	The students assisted by the tutors will be able to develop	alone simple simulation models and run with	n these scenario ana	lyses. In this manner th
	theoretical and practical knowledge from the lecture is c	onsolidated and the potential effects from d	lifferent process com	binations and bounda
	conditions highlighted. The students are able to analyse i	ndependently the operational performance of	f steam power plant	s and calculate selecte
	quantities 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	Written examination of 120 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Energy and Enviromental Engineering: C	ompulsory	
Curricula	General Engineering Science (German program): Specialisa	ation Mechanical Engineering, Focus Energy S	Systems: Compulsory	
	General Engineering Science (German program, 7 semester	r): Specialisation Energy and Enviromental En	gineering: Compulso	ry
	General Engineering Science (German program, 7 semester	r): Specialisation Mechanical Engineering, Foo	cus Energy Systems:	Elective Compulsory
	Energy and Environmental Engineering: Core qualification:	Compulsory		
	General Engineering Science (English program): Specialisa	tion Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semester			
	General Engineering Science (English program, 7 semester		us Energy Systems: E	Elective Compulsory
	Mechanical Engineering: Specialisation Energy Systems: Co	ompuisory		



	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 1st part of the lecture an overview on thermal power plants is offered, including:
	in the 1 <sup>-8</sup> part of the fectore an overview of 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 shermal 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:
	- Factory belongs of a fluid flow machine
	Energy balance of a fluid-flow machine     Theory of turbine and compressor stage
	,
	Flow losses
	Characteristic numbers  A induced continuous
	Axial and radial design  Paris for the second
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	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 discussed.
	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.
	A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with
	whole subject field of gas and steam power plants. Through discussions with plant personnel the students are able to obtain an overview on a
	operation problems and their solution approach.
	This activity hinges, however, upon the availability of support financing and as such it cannot always be guaranteed.
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I itarat	
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
	T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis



_	er Plants
Тур	Recitation Section (large)
Hrs/wk	2
СР	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 an
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discu
	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.
	responsibility of an engineer 3 own actions are emphasized and the potential extent of the unletent solutions presented cleanly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM. With this tool small task
	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.
Literature	Skripte
	Kalide: Kraft- und Arbeitsmaschinen
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
	<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>



Courses				
litle little		Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L10	35)	Lecture	2	2
Fundamentals of Materials Science II (Adv	ranced 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 i	netals, ceramics and polymers	and can describe this know	vledge comprehensiv
	Fundamental knowledge here means specifically the issues of			
	mechanical properties. The students know about the key aspe		•	
	characterizing specific properties. They are able to trace materia	is phenomena back to the underlyi	ing physical and chemical lav	ws of nature.
Skills	The students are able to trace materials phenomena back to the	e underlying physical and chemica	al laws of nature. Materials p	henomena here refer
	mechanical properties such as strength, ductility, and stiffness,	chemical properties such as corros	sion resistance, and to phase	transformations such
	solidification, precipitation, or melting. The students can explain	the relation between processing	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 Engine	ering: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compul	sory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compuls	sory	
	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		ental Engineering: Compulso	ry
	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		sory	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp		na: Compulsory	
	General Engineering Science (English program, 7 semester): Sp. General Engineering Science (English program, 7 semester): Sp.			
	General Engineering Science (English program, 7 semester): Sp.			
	General Engineering Science (English program, 7 semester): Sp.			v
	Logistics and Mobility: Specialisation Engineering Science: Elec		gcog. copulsol	,
	Mechanical Engineering: Core qualification: Compulsory	20pa.oo.,		
	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 Ma	terials 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
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 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			
	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, acquire the particular knowledge and tranfer 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 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 M0670: Particle Tec	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)		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 foll	owing learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able	to		
	name and explain processes and unit-operations of	colide process anginagring		
	characterize particles, particle distributions and to dis			
	• Characterize particles, particle distributions and to dis	ouss their bunk properties		
Skills	Students are able to			
	choose and design apparatuses and processes for solids processing according to the desired solids properties of the product			
	<ul> <li>choose and design apparatuses and processes for solids processing according to the desired solids properties of the product</li> <li>asses solids with respect to their behavior in solids processing steps</li> </ul>			
	document their work scientifically.	rocessing steps		
	document their work scientificany.			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with	other students or scientific personal and to dev	elop solutions for ted	chnical-scientific issues
	a group.			
Autonomy				
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): Specialisa	ation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa	ation 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: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 semester		sory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program, 7 semester			γ
	Process Engineering: Core qualification: Compulsory	,	. Jp21001	•



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

Course L0435: Particle Technology	
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.



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 bid	ology		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	With the completion of this module the students acqu	uire in-depth knowledge of important cause-effect of	chains of potential enviro	nmental problems wh
· ·	might occur from production processes, projects or construction measures. They have knowledge about the methodological diversity and are compet			
	in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of the			
	environmental processes as well as uncertainties an	d difficulties with their measurement.		
Skills	The students are able to select a suitable method for	or the respective case from the variety of assessm	ent methods. Thereby th	ney can develop suita
	solutions for managing and mitigating environmen	tal problems in a business context. They are at	ole to carry out Life Cy	cle Impact Assessme
	independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence			
	to critically judge research results or other publications on environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technic			
	different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into t			
	multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity and consciousness towards these subjects a			
	raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process and presen			scientific work. They of
	solve an environmental problem in a business conte	xt and are able to judge results of other publication:	S.	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 4	2		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Sp	• • • • • • • • • • • • • • • • • • • •		
Curricula	General Engineering Science (German program): Sp		•	
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory			
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualifi	• •		
	General Engineering Science (English program): Spo	• • • • • • • • • • • • • • • • • • • •		
	General Engineering Science (English program): Spi		•	
	General Engineering Science (English program, 7 se	* *		у
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program, 7 se		rective Compulsory	
	Process Engineering: Core qualification: Elective Co			
	Process Engineering: Core qualification: Compulsory	/		



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

Course L1054: 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	tals of Materials Science			
Courses				
		Time	Line hade	O.D.
Title Fundamentals of Materials Science I (L108)	25)	Typ Lecture	Hrs/wk 2	<b>CP</b> 2
	ranced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials		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 learn	ning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on metals,	ceramics and polymers and can	describe this knowl	edge comprehensively.
	Fundamental knowledge here means specifically the issues of atomic	structure, microstructure, phase dia	grams, phase transfo	rmations, corrosion and
	mechanical properties. The students know about the key aspects of			
	characterizing specific properties. They are able to trace materials pher	nomena back to the underlying physi	cal and chemical law	s of nature.
Skills	The students are able to trace materials phenomena back to the unde	rlying physical and chemical laws of	nature. Materials ph	enomena here refers to
	mechanical properties such as strength, ductility, and stiffness, chemic	al properties such as corrosion resis	tance, and to phase	transformations such as
	solidification, precipitation, or melting. The students can explain the re	lation between processing condition	is and the materials	microstructure, and they
	can account for the impact of microstructure on the material's behavior.			
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 Energ		mpulsory	
Curricula	General Engineering Science (German program): Specialisation Mecha			
	General Engineering Science (German program): Specialisation Biome General Engineering Science (German program): Specialisation Naval			
	General Engineering Science (German program, 7 semester): Specialist		pulsorv	
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis			
	General Engineering Science (German program, 7 semester): Specialis	sation Energy and Enviromental Eng	ineering: Compulsory	/
	Energy and Environmental Engineering: Core qualification: Compulsor	у		
	General Engineering Science (English program): Specialisation Energy	and Enviromental Engineering: Cor	npulsory	
	General Engineering Science (English program): Specialisation Mecha	nical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Biome			
	General Engineering Science (English program): Specialisation Naval			
	General Engineering Science (English program, 7 semester): Specialis			
	General Engineering Science (English program, 7 semester): Specialis General Engineering Science (English program, 7 semester): Specialis		•	
	General Engineering Science (English program, 7 semester): Specialis General Engineering Science (English program, 7 semester): Specialis			,
	Logistics and Mobility: Specialisation Engineering Science: Elective Co		locinig. Compuisory	
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective C	compulsory		
		<del>-</del>		



Course L1085: Fundamentals of Ma	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	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	nel Design of Mataviala Cajanaa
•	Lecture
Hrs/wk	
CP	2
	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
	· ·



Module M0634: Introductio	n into Medical Technology and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction into Medical Technology and	Systems (L0342)	Lecture	2	3
Introduction into Medical Technology and		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			
	Fg,g,			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	owing learning results		
Professional Competence				
Knowledge	The students can explain medical technology and its princi	oles, including imaging systems, computer ai	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.	
01.71	The state of the s	and the self-term and self-term		
Skills	The students are able to apply principles of medical technology	ogy to solving actual problems.		
Personal Competence				
Social Competence	The students describe a problem in medical technology as a	project, and define tasks that are solved in a	joint effort.	
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.		manner.	
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 semester	r): Specialisation Biomedical Engineering: Co	mpulsory	
	Computer Science: Specialisation Computer and Software E	ingineering: Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Compulsi	ory		
	General Engineering Science (English program): Specialisa	tion Biomedical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester	: Specialisation Biomedical Engineering: Cor	npulsory	
	Computational Science and Engineering: Specialisation Eng	gineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisation Co	mputer Science: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs and	Regenerative Medicine: Elective Compulsory	/	
	Biomedical Engineering: Specialisation Implants and Endop	rostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology	and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and B	usiness Administration: Elective Compulsory		
	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		
	- 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
СР	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



urses				
le		Tun	Hrs/wk	CP
		Typ Lecture	Hrs/wk 3	4 4
nals and Systems (L0432) nals and Systems (L0433)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	Mathematics 1-3			
Momeage	The modul is an introduction to the theory of signals and systems. Go Further experience with spectral transformations (Fourier series, Fourier			iematik 1-3 is expe
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-i	nvariant (LTI) systems using metho	ods of signal and syste	m theory. They are
	to apply the fundamental transformations of continuous-time and discret	e-time signals and systems. They	can describe and analy	yse deterministic siç
	and systems mathematically in both time and image domain. In partic	ular, they understand the effects	in time domain and in	nage domain which
	caused by the transition of a continuous-time signal to a discrete-time si	gnal.		
Skills	The students are able to describe and analyse deterministic signals an	d linear time-invariant systems usi	ing methods of signal a	and system theory.
	can analyse and design basic systems regarding important properties	such as magnitude and phase res	ponse, stability, lineari	ity etc They can as
	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 conf	trol their level of know	ledge during the le
,	period by solving tutorial problems, software tools, clicker system.	.,		3
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
	6			
·				
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Electric			
Curricula	General Engineering Science (German program): Specialisation Compo			
	General Engineering Science (German program): Specialisation Proces			
	General Engineering Science (German program): Specialisation Biopro	cess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Civil-a	nd Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Mecha	nical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biome	dical Engineering: Compulsory		
	$General\ Engineering\ Science\ (German\ program, 7\ semester):\ Special is$	ation Electrical Engineering: Comp	oulsory	
	$General\ Engineering\ Science\ (German\ program,\ 7\ semester):\ Special is$	ation Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialis	ation Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7 semester): Specialis	ation Bioprocess Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): Specialis	ation Biomedical Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering, Foo	cus Biomechanics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering, Foo	cus Energy Systems: C	ompulsory
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering, Foo	cus Aircraft Systems Er	ngineering: Compul
	General Engineering Science (German program, 7 semester): Spec	ialisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering, For	cus Mechatronics: Corr	npulsory
	General Engineering Science (German program, 7 semester): Speci			
	Compulsory	39		3
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil-a	nd Enviromental Engeneering: Cor	mpulsory	
	General Engineering Science (English program): Specialisation Bioprod		- -	
	General Engineering Science (English program): Specialisation Electric			
	General Engineering Science (English program): Specialisation Compu	0 0 1 ,		
	General Engineering Science (English program): Specialisation Mecha			
	General Engineering Science (English program): Specialisation Biomed			
	General Engineering Science (English program): Specialisation Biomet			
	General Engineering Science (English program, 7 semester): Specialisation Proces		ulsorv	
	General Engineering Science (English program, 7 semester): Specialisa General Engineering Science (English program, 7 semester): Specialisa		•	
	General Engineering Science (English program, 7 semester): Specialisa General Engineering Science (English program, 7 semester): Specialisa			
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	General Engineering Science (English program, 7 semester): Specialisa General Engineering Science (English program, 7 semester): Specialisa			
	General Engineering Science (English program, 7 semester): Specialisa General Engineering Science (English program, 7 semester): Specialisa			nnulsory
	General Engineering Science (English program, 7 semester): Specialist General Engineering Science (English program, 7 semester): Specialist			
		-		
	General Engineering Science (English program, 7 semester): Specialisa			
	General Engineering Science (English program, 7 semester): Spec	alisation Mechanical Engineerinç	J, ⊢ocus Materials in	⊏ngineering Scier
	Compulsory	ation Machanian Francisco	nua Maakataa ' · · · · · ·	unulaan:
	General Engineering Science (English program, 7 semester): Specialisa			
	General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Engineering	, Focus Theoretical N	lechanical Enginee
	General Engineering Science (English program, 7 semester): Special Compulsory  Computational Science and Engineering: Core qualification: Compulso		, Focus Theoretical N	Mechanical Enginee



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 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 M0680: Fluid Dynar	nice				
iniodule iniodou. Fluid Dyllai	ilics				
Courses					
Title		Тур	Hrs/wk	СР	
Fluid Mechanics (L0454)		Lecture	3	4	
Fluid Mechanics (L0455)		Recitation Section (large)	2	2	
Module Responsible	Prof. Thomas Rung				
Admission Requirements	none				
Recommended Previous	Sound knowledge of engineering mathematics, engineering me	echanics and thermodynamics.			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following	ng learning results			
Professional Competence					
Knowledge	Students will have the required sound knowledge to explain the	e general principles of fluid engineering an	d physics of fluids. S	Students can scientificall	
	outline the rationale of flow physics using mathematical mode	s 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	s-physics models for the analysis of technics	al evetame. The lectu	ira anablae tha etiidant te	
OKIIIS	carry out all necessary theoretical calculations for the fluid dyna			ire eriables the student to	
	sary caraminesseary ansoroned caronidations for the hard dyna	doolgir or originoomig do 1000 on d oolo			
Personal Competence					
Social Competence	The students are able to discuss problems and jointly develop s	solution strategies.			
Autonomy	The students are able to develop solution strategies for complex	c problems self-consistent and crtically analy	yse 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): Specialisatio	n Mechanical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisatio	n Biomedical Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory				
	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): S		ry		
	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, 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 Naval Architecture: Compulsory				
	Computational Science and Engineering: Specialisation Engine		y		
	Mechanical Engineering: Core qualification: Compulsory	John Goldings . Elective Compulsory			
	Naval Architecture: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory			
	and the second s				

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 M0960: Mechanics	IV (Kinetics II, Oscillations, Analytical Mecha	nics, Multibody Systems)			
Courses					
Title		Тур	Hrs/wk	СР	
	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3	
	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2	
lechanics IV (Kinetics II, Oscillations, An	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 foll	owing learning results			
Professional Competence					
Knowledge	The students can				
	describe the axiomatic procedure used in mechanical	al contexts:			
	explain important steps in model design;	ii comozia,			
	present technical knowledge.				
	procent teet mice meage.				
Skills	The students can				
	explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;      apply basic methods to provide problems;				
	<ul> <li>apply basic methods to engineering problems;</li> <li>estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.</li> </ul>				
	- Commute the reach and boundaries of the methods at	a exteria arem to be approable to wider proble			
Personal Competence					
Social Competence	The students can work in groups and support each other to o	overcome difficulties.			
Autonomy	Students are capable of determining their own strengths and	I 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	ation Mechanical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisa	ation Biomedical Engineering: Compulsory			
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory				
	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 semeste	r): Specialisation Naval Architecture: Compulso	ry		
	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, 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 Naval Architecture: Compulsory				
	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 Compulsor	y			
	Theoretical Mechanical Engineering: Technical Complemen	tary Course Core Studies: Elective Compulsory	,		

Course L1137: Mechanics IV (Kineti	Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Lecture		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Robert Seifried		
Language	DE		
Cycle	SoSe		
Content	- Simple impact problems		
	- Principles of analytical mechanics		
	- Elements of vibration theory		
	- 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 (Kineti	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 (Kineti	ourse 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	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 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	dependent Study Time 62, Study Time in Lecture 28		
Lecturer	of. 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		



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irses		T	Here fords	0.0
eduction to Radiology and Radiation Tl	perany /I 0383\	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Prof. Ulrich Carl	Lecture	2	3
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the	he following learning results		
Professional Competence				
Knowledge	Thorapy			
	Therapy			
	The students can distinguish different types of currentl	y used equipment with respect to its use in radia	ation therapy.	
	The students can explain complex treatment plans use	ed in radiation therapy in interdisciplinary conte	xts (e.g. surgery, internal me	edicine).
	The students can describe the patients' passage from	their initial admittance through to follow-up care	ı.	
	Diagnostics			
	The students can illustrate the technical base conce imaging techniques (CT, MRT, US).	epts of projection radiography, including angion	ography and mammograph	y, as well as section
	The students can explain the diagnostic as well as the	rapeutic use of imaging techniques, as well as t	the technical basis for those	techniques.
	The students can choose the right treatment method d	epending on the patient's clinical history and ne	eeds.	
	The student can explain the influence of technical erro	ors on the imaging techniques.		
	The student can draw the right conclusions based on t	the images' diagnostic findings or the error proto	ocol	
	The state of the s	oagoo alagiiooloago oi ilio oiioi piolo	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Skills	Thorany			
	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 radiate energy needed in that situation (irradiation planning).	ne situation (location of the	tumor) and choose	
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help gr social services, psycho-oncology).			
	Diagnostics			
	The students can suggest solutions for repairs of imag	ing instrumentation after having done error ana	lyses.	
	The students can classify results of imaging techniques according to different groups of diseases based on their knowl pathophysiology.			anatomy, pathology a
	patrophysiology.			
Personal Competence				
Social Competence	The students can assess the special social situation of	f tumor nations and interact with them in a profe	esional way	
	The students can assess the special social situation of	rumor patients and interact with them in a profe	ssional way.	
	The students are aware of the special, often fear-domi	nated behavior of sick people caused by diagn	ostic and therapeutic measu	ures and can meet th
	appropriately.			
Autonomy				
	The students can apply their new knowledge and skills	s to a concrete therapy case.		
	The students can introduce younger students to the clinical daily routine.			
	The students are able to access anatomical knowle relevant knowledge themselves.	dge by themselves, can participate competer	ntly in conversations on the	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): Spe			
Curricula	General Engineering Science (German program): Spe General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 set			npulsory
	Electrical Engineering: Specialisation Medical Techno			
	General Engineering Science (English program): Spec			
	General Engineering Science (English program): Spe- General Engineering Science (English program): Spe- General Engineering Science (English program, 7 ser	cialisation Biomedical Engineering: Compulsor	у	inulsorv



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			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer Language	Prof. Ulrich Carl, Prof. Thomas Vestring  DE			
Cycle	SoSe 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 M0598: Mechanica	Engineering: Design				
Courses					
Title		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	
Team Project Design Methodology (L0267	")	Problem-based Learning	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 following	ng learning results			
Professional Competence					
Knowledge	After passing the module, students are able to:				
	<ul> <li>explain design guidelines for machinery parts e.g. consi</li> </ul>	dering load situation, materials and manu	facturing requirements	i,	
	describe basics of 3D CAD,		- ,		
	<ul> <li>explain basics methods of engineering designing.</li> </ul>				
CI-III-	After a section the great deal of the death are selected.				
Skilis	After passing the module, students are able to:				
	<ul> <li>independently create sketches, technical drawings and documentations e.g. using 3D CAD,</li> </ul>				
	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:				
,					
	develop and evaluate solutions in groups including making and documenting decisions,				
	<ul> <li>moderate the use of scientific methods,</li> </ul>				
	present and discuss solutions and technical drawings w	ithin groups,			
	reflect the own results in the work groups of the course.				
Autonomy	Students are able				
	to a street distributed and a file of the contract of the cont	allow the contribution to the state of the state of	- )		
	to estimate their level of knowledge using activating me	ethods within the lectures (e.g. with clicker	s),		
	<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): Specialisatio	n Energy and Enviromental Engineering:	Compulsory		
Curricula	General Engineering Science (German program): Specialisatio	n Mechanical Engineering: Compulsory			
	General Engineering Science (German program): Specialisatio	n Biomedical Engineering: Compulsory			
	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): S	Specialisation Energy and Enviromental E	ngineering: Compulso	ry	
	Energy and Environmental Engineering: Core qualification: Cor	mpulsory			
	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, 7 semester): S	pecialisation Mechanical Engineering: Co	ompulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering: Co	mpulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Energy and Enviromental Er	ngineering: Compulsor	у	
	Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				



Course L0268: Embodiment Design	and 3D-CAD	
Тур	ecture	
Hrs/wk		
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	Basics of 3D CAD technology  Practical course to apply a 3D CAD system  Introduction to the system  Sketching and creation of components  Creation of assemblies  Deriving technical drawings	
Literature	<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-Ill; 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	ctical 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	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	SoSe	
Content	Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing)	
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH., Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.	

Course L0267: Team 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>	



Madela MOCAC: DIO Islamba	nto and Tasting			
Module M0646: BIO I: Impla	nts and Testing			
Courses				
Title		Тур	Hrs/wk	СР
Experimental Methods in Biomechanics (L	0377)	Lecture	2	3
mplants and Fracture Healing (L0376)		Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate und Frakturheilu	ng" before attending "Experimentelle N	Methoden".	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results		
Professional Competence				
Knowledge	The students can describe the different ways how bones heal,	and the requirements for their existence	9.	
	The students can name different treatments for the spine and he	ollow bones under given fracture morp	hologies.	
	The students can describe different measurement techniques for	or forces and movements, and choose	the adequate technique for	a given task.
Skills	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.			
	The students can describe the basic handling of several experi	mental techniques used in biomechani	ics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic experimental tasks.			
Autonomy	The students can, in groups, solve basic experimental tasks.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, many questions			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Bior	nechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester):		•	mpulsory
	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engineering	: Compulsory	
	General Engineering Science (English program): Specialisation	n Biomedical Engineering: Compulsory	/	
	General Engineering Science (English program): Specialisation	n Mechanical Engineering, Focus Biom	nechanics: Compulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engineering	, Focus Biomechanics: Cor	npulsory
	General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering:	Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compu	Isory	•	
	Biomedical Engineering: Specialisation Artificial Organs and R	egenerative Medicine: Elective Compu	lsory	
	Biomedical Engineering: Specialisation Implants and Endopros	•	*	
	Biomedical Engineering: Specialisation Medical Technology at	• •	у	
	Biomedical Engineering: Specialisation Management and Busi		•	
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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



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



Courses				
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 or	english) <b>or</b> Analysis & Linear Algebra I + II for	r Technomathematicia	ans
	basic MATLAB knowledge			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge	Students are able to			
, and medge				
	<ul> <li>name numerical methods for interpolation, integration</li> </ul>	on, least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and
	explain their core ideas,			
	<ul> <li>repeat convergence statements for the numerical met</li> </ul>	hods,		
	<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 methods as		aorithm	
	select and execute a suitable solution approach for a		gonum,	
	Solect and execute a suitable solution approach for a	given problem.		
Personal Competence				
Social Competence	Students are able to			
	a work together in heterogeneously compaced tooms	(i.e. teems from different study programs on	d bookground knowle	dae) evalein theoreti
	work together in heterogeneously composed teams  foundations and support each other with practical age.			uge), explain illeoreill
	foundations and support each other with practical asp	ects regarding the implementation of algorith	115.	
Autonomy	Students are capable			
	to the second collection of the second collect	are a la companya da a la	and a second	
	to assess whether the supporting theoretical and practical and prac		or in a team,	
	<ul> <li>to assess their individual progess and, if necessary, to</li> </ul>	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: Compulsory	
	General Engineering Science (German program): Specialisa			nces: Compulsory
	General Engineering Science (German program): Specialisa		g	,
	General Engineering Science (German program, 7 semester		orv	
	General Engineering Science (German program, 7 semes	·	•	Engineering Science
	Compulsory	, ,	•	
	General Engineering Science (German program, 7 semester	: Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester			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	ry		
	General Engineering Science (English program): Specialisat	ion Computer Science: Compulsory		
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Biomecha	anics: Compulsory	
	General Engineering Science (English program): Specialisat			ces: Compulsory
	General Engineering Science (English program, 7 semester)	Specialisation Computer Science: Compulso	ory	•
	General Engineering Science (English program, 7 semes			Engineering Science
	Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engineering: Com	npulsory	
	General Engineering Science (English program, 7 semester)			mpulsory
	Computational Science and Engineering: Core qualification:			•
	Computational Ocience and Engineering. Oore qualification.	Compulsory		



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



Madula MOCOA: Uset Transit				
Module M0684: Heat Trans	er			
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)		Recitation Section (large)	2	1
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 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	approach.		
Autonomy	The students are able to develop a complex problem self-consiste	ent and analyse the results in a critical wa	v. A qualified exchan	ae with other students is
,	given.		, ,,	9
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 M			
Curricula	General Engineering Science (German program): Specialisation M		ystems: Compulsory	
	General Engineering Science (German program): Specialisation E		al Machanical Engine	poring: Compulsory
	General Engineering Science (German program): Specialisation M General Engineering Science (German program, 7 semester): Specialisation M			
	General Engineering Science (German program, 7 semester): Spe			
	Compulsory	opecialisation Mechanical Engineering,	rocus medical n	lechanical Engineening.
	General Engineering Science (German program, 7 semester): Spe	ecialisation Biomedical Engineering: Com	nnulsorv	
	General Engineering Science (English program): Specialisation B	* *	i	
	General Engineering Science (English program): Specialisation M		nics: Compulsory	
	General Engineering Science (English program): Specialisation M			
	General Engineering Science (English program): Specialisation M			ering: Compulsory
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering, Focu	ıs Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): \$	Specialisation Mechanical Engineering,	Focus Theoretical M	lechanical Engineering:
	Compulsory			
	General Engineering Science (English program, 7 semester): Spe	cialisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Comput	sory		
	Mechanical Engineering: Specialisation Theoretical Mechanical E	ngineering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, 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	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



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 a	area of measurement technology and solution	on annroaches as wel	I 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 them 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): Specialisat			
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester)		gineering: Compulsor	γ
	General Engineering Science (German program, 7 semester)			-
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semester)			
	Energy and Environmental Engineering: Core qualification: C		-	
	General Engineering Science (English program): Specialisati	on Energy and Enviromental Engineering: C	ompulsory	
	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 Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Environmental En	gineering: Compulsor	y
	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
Hum hade	
	2
	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Wolfgang Schröder
. 33.	DE
,	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. 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 Michel 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., Wissenschaftl Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münch 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>
	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 Techr	nology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Language	DE Wo
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	
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 M1270: MED III Inter	eduction to Riochemistry and Molecul	ar Riology		
Widdule Wi1279: WED II: Intro	oduction to Biochemistry and Molecul	ai biology		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and Molecula	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge				
	The students can			
	<ul> <li>describe basic biomolecules;</li> </ul>			
	explain how genetic information is coded in	the DNA:		
	explain the connection between DNA and p			
Skills				
	The students can			
	recognize the importance of molecular para	meters for the course of a disease;		
	describe different molecular-diagnostic treat	ments;		
	describe the importance of those treatments for our	o diagona.		
	describe the importance of those treatments for som	e diseases;		
Personal Competence				
Social Competence				
	The students can conduct discussions in research a	and medicine on a technical level.		
Autonomy	The students can develop understanding of topics f	com the course using technical literature, by themse	alves	
riationomy	The stadents can develop understanding of topics i	on the course, using commed meratare, by themse	51400	
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): S	pecialisation Mechanical Engineering, Focus Biome	echanics: Compulsory	
Curricula	General Engineering Science (German program): S	pecialisation Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7	semester): Specialisation Biomedical Engineering:	Compulsory	
		semester): Specialisation Mechanical Engineering,	Focus Biomechanics: Com	pulsory
	Electrical Engineering: Specialisation Medical Tech			
		pecialisation Mechanical Engineering, Focus Biome	echanics: Compulsory	
	General Engineering Science (English program): S		France Diament and the C	
		semester): Specialisation Mechanical Engineering, I		puisory
		emester): Specialisation Biomedical Engineering: Computerry	Jonipulsory	
	Mechanical Engineering: Specialisation Biomechan		n/	
	Biomedical Engineering: Specialisation Manageme Biomedical Engineering: Specialisation Artificial On			
	Biomedical Engineering: Specialisation Artificial On Biomedical Engineering: Specialisation Medical Te	•	501 y	
	Biomedical Engineering: Specialisation invention re			
	Technomathematics: Core qualification: Elective Co	· · ·		
	Technomathematics: Specialisation III. Engineering	· · ·		
	, 3 3			

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



Module M0829: Foundation				
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	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	results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many differ Marketing and Innovation, and also to Investment and Controlling. In particu		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management and to	he sub-disciplines in Managen	nent and to name impo	ortant definitions from t
	field of Management			
	<ul> <li>explain the most important aspects of and goals in Management and</li> <li>describe and explain basic business functions as production, proc</li> </ul>			
	ressource management, information management, innovation mana		chain management,	organization and num
	explain the relevance of planning and decision making in Busines		Iltiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance	•		
	state basics from accounting and costing and selected controlling m	ethods.		
Skills	Students are able to analyse business units with respect to differer Entrepreneurship project in a team. In particular, they are able to	nt criteria (organization, object	ctives, strategies etc	) and to carry out
	Market Ma			
	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			
	analyse and apply basic methods of marketing	•		
	select and apply basic methods from mathematical finance to predef	fined problems		
	apply basic methods from accounting, costing and controlling to pre-	defined problems		
Personal Competence				
Social Competence	Students are able to			
	a constitution of the state of the state of			
	work successfully in a team of students     to apply their knowledge from the lecture to an entrepreneurship pro	iect and write a coherent renor	t on the project	
	to communicate appropriately and	ject and write a conferent repor	ton 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				
Credit points  Examination	6 Written exam			
Examination duration and scale				
Assignment for the Following	90 Minuten  General Engineering Science (German program): Specialisation Electrical I	Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Clearliest General Engineering Science (German program): Specialisation Computer			
	General Engineering Science (German program): Specialisation Process E			
	General Engineering Science (German program): Specialisation Bioproces	s Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy an	d Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program): Specialisation Civil- and	Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Mechanica			
	General Engineering Science (German program): Specialisation Biomedica			
	General Engineering Science (German program): Specialisation Naval Arcl General Engineering Science (German program, 7 semester): Specialisatio		vulcon.	
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisatio		•	
	General Engineering Science (German program, 7 semester): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisatio	•	•	
	General Engineering Science (German program, 7 semester): Specialisatio	n Bioprocess Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): Specialisatio	n Civil Engineering: Compulso	ry	
	General Engineering Science (German program, 7 semester): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisatio		•	
	General Engineering Science (German program, 7 semester): Specialis Compulsory	sauon wechanical Engineerin	y, rocus iviateriais in	Linginieering Science
	General Engineering Science (German program, 7 semester): Specialise	ation Mechanical Engineering	. Focus Theoretical M	Mechanical Engineeri
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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
Compulsory

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. Wolfgang
	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 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
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: Intro	oduction to Physiology			
^				
Courses		T	Her fed.	0.0
Fitle		Тур	Hrs/wk	CP
ntroduction to Physiology (L0385)	D. D 7	Lecture	2	3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous	None			
Knowledge	A6-stall-second second Head about the control of the Called	a La conferencia de la		
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	<del>-</del>			
	The students can			
	describe the basics of the energy metabolism;			
	<ul> <li>describe physiological connections in select fields of mus</li> </ul>	cle, heart/circulation, neuro- and se	ensory physiology.	
Skills				
	The students can			
	describe the effects of basic bodily functions (sensory, tra	nsmission and processing of inform	nation, development of forces	and vital functions) a
	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 physiol	ogy, both analytical and metrologic	cal	
Autonomy	The students can develop understanding of topics from the cours	e, using technical literature, by the	mselves	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes	Markaria E. Caranton E. Caranton		
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 General Engineering Science (German program, 7 semester): Sp	-		mouleon
	Electrical Engineering: Specialisation Medical Technology: Elect		ng, rocus biomechanics. Coi	привогу
	General Engineering Science (English program): Specialisation		omechanics: Compulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp			npulsorv
	General Engineering Science (English program, 7 semester): Sp	•	-	paicory
	Mechanical Engineering: Specialisation Biomechanics: Compuls		9	
	Biomedical Engineering: Specialisation Medical Technology and	•	ory	
	Biomedical Engineering: Specialisation Management and Busine			
	Biomedical Engineering: Specialisation Artificial Organs and Rec	·	•	
	Biomedical Engineering: Specialisation Implants and Endoprost			
	Technomathematics: Core qualification: Elective Compulsory	, ,		
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

Course L0385: Introduction to Phys	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	



## **Specialization Naval Architecture**

Module M0933: Fundamen	tals of Materials Science				
Courses					
Title		Тур	Hrs/wk	CP	
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	s 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 lea	arning results			
Professional Competence					
Knowledge	The students have acquired a fundamental knowledge on metal	ls, ceramics and polymers and c	an describe this knowl	ledge comprehensively	
Ü	Fundamental knowledge here means specifically the issues of atom				
	mechanical properties. The students know about the key aspects of				
	characterizing specific properties. They are able to trace materials ph	enomena back to the underlying ph	ysical and chemical law	s of nature.	
Skills	The students are able to trace materials phenomena back to the unc	derlying physical and chemical laws	s of nature. Materials ph	nenomena here refers to	
	mechanical properties such as strength, ductility, and stiffness, chem	nical properties such as corrosion re	esistance, and to phase	transformations such as	
	solidification, precipitation, or melting. The students can explain the	relation between processing condi	tions and the materials	microstructure, and they	
	can account for the impact of microstructure on the material's behavior	or.			
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 Ene	ray and Enviromental Engineering:	Compulsory		
Curricula	General Engineering Science (German program): Specialisation Med		, ,		
	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 Mechanical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specia	alisation Biomedical Engineering: C	ompulsory		
	General Engineering Science (German program, 7 semester): Specia	alisation Naval Architecture: Compu	lsory		
	General Engineering Science (German program, 7 semester): Specia	alisation Energy and Enviromental E	ingineering: Compulsor	y	
	Energy and Environmental Engineering: Core qualification: Compuls	ory			
	General Engineering Science (English program): Specialisation Ener	rgy and Enviromental Engineering:	Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biom	nedical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Nava	al Architecture: Compulsory			
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering: Co	ompulsory		
	General Engineering Science (English program, 7 semester): Specia	lisation Biomedical Engineering: Co	mpulsory		
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Ocience (English program, 7 semester). Opecia				
	Logistics and Mobility: Specialisation Engineering Science: Elective 0	Compulsory	3 · · · 3 · · · · · · · · · · · · · · ·		
		Compulsory	g g p,		
	Logistics and Mobility: Specialisation Engineering Science: Elective (	Compulsory	3 3 p		
	Logistics and Mobility: Specialisation Engineering Science: Elective ( Mechanical Engineering: Core qualification: Compulsory	Compulsory			
	Logistics and Mobility: Specialisation Engineering Science: Elective of Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory		J J ,		



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	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	se 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	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			



courses				
itle		Тур	Hrs/wk	CP
troduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	3	3
Module Responsible	Prof. Christoph Ihl	1 Tobletti-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 results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of m Marketing and Innovation, and also to Investment and Controlling.		anagement, from Plan	ning and Organisation
	explain the differences between Economics and Managem field of Management	ent and the sub-disciplines in Manager	ment and to name impo	ortant definitions from t
	field of Management  explain the most important aspects of and goals in Manage	ment and name the most important asp	ects of entreproeurial i	orniects
	describe and explain basic business functions as product			
	ressource management, information management, innovat			
	explain the relevance of planning and decision making in	Business, esp. in situations under m	ultiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	<ul> <li>state basics from accounting and costing and selected cont</li> </ul>	rolling methods.		
Skills	Students are able to analyse business units with respect to Entrepreneurship project in a team. In particular, they are able to	different criteria (organization, obje	ectives, strategies etc	.) and to carry out
	analyse Management goals and structure them appropriate	alv		
	analyse organisational and staff structures of companies	.,		
	apply methods for decision making under multiple objective	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>			
	select and apply basic methods from mathematical finance			
	<ul> <li>apply basic methods from accounting, costing and controlli</li> </ul>	ng 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 entrepreneu	rship project and write a coherent repo	rt 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			
	<ul> <li>to write a report on their project.</li> </ul>			
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 E	lectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation C	omputer Science: Compulsory		
	General Engineering Science (German program): Specialisation P			
	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation C			
	General Engineering Science (German program): Specialisation M		impulsory	
	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation N	aval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Spe	cialisation Electrical Engineering: Com	pulsory	
	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			
	General Engineering Science (German program, 7 semester): Spe			у
	General Engineering Science (German program, 7 semester): Spe			
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Fo	cus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester): Spe		-	
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineerin	g, Focus Materials ir	Engineering Scienc
	Compulsory			



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	
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. Wolfg	
	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	
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	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
offerential 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
omplex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge				
_	Students can name the basic concepts in Mathem			
	Students can discuss logical connections between	n these concepts. They are capable of illustrating the	nese connections w	ith the help of exampl
	<ul> <li>They know proof strategies and can reproduce the</li> </ul>	em.		
Skills				
	Students can model problems in Mathematics IV	with the help of the concepts studied in this course	. Moreover, they are	e capable of solving the
	by applying established methods.			
	Students are able to discover and verify further log	•		
	For a given problem, the students can develop an	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>			
	<ul> <li>In doing so, they can communicate new concepts</li> </ul>	s according to the needs of their cooperating partn	ers. Moreover, they	can design example
	check and deepen the understanding of their pee	rs.		
Autonomy				
	<ul> <li>Students are capable of checking their understar</li> </ul>	iding of complex concepts on their own. They can	specify open ques	tions precisely and ki
	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			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equation	ons 2)		
Assignment for the Following	General Engineering Science (German program): Specia	lisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specia		ics: Compulsory	
	General Engineering Science (German program): Specia	• •		eering: Compulsory
	General Engineering Science (German program): Specia	• •		comig. compalcoly
	General Engineering Science (German program, 7 seme	· ·	leon/	
	General Engineering Science (German program, 7 seme-	, ,	,	mpulcon
	General Engineering Science (German program, 7 series			
		nester). Specialisation Mechanical Engineering,	rocus mediencai	wechanical Engineer
	Compulsory	ota de Caracia lisa di sa Nasa di Asabita da sa Caracia la sa		
	General Engineering Science (German program, 7 seme	, ,	у	
	Computer Science: Specialisation Computational Mather	natics: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special	• •		
	General Engineering Science (English program): Special	isation Mechanical Engineering, Focus Theoretical	Mechanical Engine	eering: Compulsory
	General Engineering Science (English program, 7 semes	ter): Specialisation Electrical Engineering: Comput	sory	
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engineering, Focus	Mechatronics: Cor	mpulsory
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineer
	Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Naval Architecture: Compulsor	/	
	Computational Science and Engineering: Specialisation			
	Computational Science and Engineering: Specialisation			
	Mechanical Engineering: Specialisation Theoretical Mechanical			
	Mechanical Engineering: Specialisation Mechatronics: C			
	Mechatronics: Core qualification: Compulsory	ompaisory		
	, , ,			
		contany Course Core Studios: Elective Cores		
	Naval Architecture: Core qualification: Compulsory	nantary 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 Equation	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, Analytical 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 follo	wing learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in mechanical	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 / mecl	nanical analysis and model formation, and ap-	ply it to the context of	their own problems:
	<ul> <li>apply basic methods to engineering problems;</li> </ul>	, , , , , , , , , , , , , , , , , , , ,	, ,	,
	estimate the reach and boundaries of the methods and	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 o	rercome difficulties.		
Autonomy	Students are capable of determining their own strengths and	weaknesses and to organize their time and le	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): Specialisat	ion Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester)		npulsory	
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semester)			
	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			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Complement	ary Course Core Studies: Elective Compulsor	у	

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 Dynar	nice			
iniodule iniodou. Fluid Dyllai	ilics			
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	none			
Recommended Previous	Sound knowledge of engineering mathematics, engineering me	echanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the	e general principles of fluid engineering an	d physics of fluids. S	Students can scientificall
	outline the rationale of flow physics using mathematical mode	s 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	s-physics models for the analysis of technics	al evetame. The lectu	ira anablae tha etiidant te
OKIIIS	carry out all necessary theoretical calculations for the fluid dyna			ire eriables the student to
	sary caraminesseary ansoroned caronidations for the hard dyna	doolgir or originoomig do 1000 on d oolo		
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop s	solution strategies.		
Autonomy	The students are able to develop solution strategies for complex	c problems self-consistent and crtically analy	yse 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): Specialisatio	n Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisatio	n Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisatio	, ,		
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S		ry	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	• •	nulcon	
	General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S			
	General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S			
	Computational Science and Engineering: Specialisation Engine		y	
	Mechanical Engineering: Core qualification: Compulsory	John Goldings . Elective Compulsory		
Naval Architecture: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		
	and the second s			

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: Stochastics	s and Ship Dynamics			
Courses				
Title		Тур	Hrs/wk	CP
Ship Dynamics (L0352)		Lecture	2	3
Ship Dynamics (L1620)		Recitation Section (small)	1	1
	val Architecure and Ocean Engineering (L0364)	Lecture	2	3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous	a Taskaisal asaahasisa			
Knowledge	Technical mechanics     Linear algebra, analysis, compley numbers			
	Linear algebra, analysis, complex numbers     Fluid mechanics			
	Thur modification			
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	- The students are able to give an overview over various manoeuvres.	They can name application goals and	I they can descri	be the procedure of the
	manoeuvres.			
	- The students are able to give an overview over varius rudder types. They	can name criteria in the rudder design	n.	
	- The students can name computation methods which are used to determi	ne forces and motions in waves.		
Skills	- The students can come up with the equations of motions which are used	to discribe manageners. The can use	and linearise the	m
Okino	The stateme can come up with the equations of motions which are used	to discribe manocavies. The san ase	and integrise the	
	- The students are able to determine hydrodynamic coefficients and they of	an explain their physical meaning.		
	The students can explain how a rudder works and they can explain the physical effects which can occur.			
	- The students can mathematically describe waves.			
	- The students can explain the mathematically description of harmoncial m	notions in waves and they can determi	ne them.	
Personal Competence				
Social Competence	- The students can arrive at work results in groups and document them.			
	- The students can discuss in groups and explain their point of view.			
Autonomy	- The students can assess their own strengthes and weaknesses and the	define further work steps on this 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): Specialisation Naval Ar	chitecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisat	ion Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisation Naval Arc	chitecture: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisati	on Naval Architecture: Compulsory		
	Naval Architecture: Core qualification: Compulsory			



Course L0352: Ship Dynamics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships
	<ul> <li>Equations of motion</li> <li>Hydrodynamic forces and moments</li> <li>Linear equations and their solutions</li> <li>Full-scale trials for evaluating the maneuvering performance</li> <li>Regulations for maneuverability</li> <li>Rudder</li> </ul> Seakeeping <ul> <li>Representation of harmonic processes</li> <li>Motions of a rigid ship in regular waves</li> <li>Flow forces on ship cross sections</li> <li>Strip method</li> <li>Consequences induced by ship motion in regular waves</li> <li>Behavior of ships in a stationary sea state</li> <li>Long-term distribution of seaway influences</li> </ul>
Literature	<ul> <li>Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg 2014</li> <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> <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> <li>Handbuch der Werften, Deutschland, 1986</li> <li>Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001</li> <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> <li>Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004</li> <li>Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998</li> </ul>

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	<ul> <li>descriptive statistics, parameter, criteria for outliers</li> <li>sample, sample space, probability, probability space</li> <li>Bayes method, conditional probability, law of total probability</li> <li>Discrete and continuous random variables</li> <li>Probability distributions</li> <li>mixed and joint random variables and their distribution</li> <li>Characteristics of random variables (expectation, variance, skewness, kurtosis,)</li> <li>(central) limit theorem</li> <li>Stochastic processes</li> <li>Statistical description of seaway, harmonic analysis of seaway</li> <li>narrow-banded Gaussian process, seaway and its characteristics</li> <li>sea- and wind spectra</li> <li>transformation of spectra, transfer function</li> </ul>
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



Madula MOSEE Computation	and Elvid Dynamica I			
Module M0655: Computation	onal Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
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 Mathematical Francisco			
Knowledge	<ul> <li>Mathematical Methods for Engineers</li> <li>Fundamentals of Differential/integral calculus and s</li> </ul>	orios expansions		
	Fundamentals of Differential/integral calculus and s	eries expansions		
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial di	ferential equations.		
Skills	The students are able develop appropriate numerical int	egration in space and time for the governing	partial differential ed	quations. They can code
	computational algorithms in a structured way.			
B				
Personal Competence				
Social Competence	The students can arrive at work results in groups and docur	nent them.		
Autonomy	The students can independently analyse approaches to sol	ving 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): Specialis	ation Mechanical Engineering, Focus Energy Sy	stems: Compulsory	
Curricula	General Engineering Science (German program): Specialis	ation Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semeste	er): Specialisation Naval Architecture: Compulso	ry	
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engineering, Foci	us Energy Systems: I	Elective Compulsory
	General Engineering Science (English program): Specialis	ation Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialis	ation Mechanical Engineering, Focus Energy Sy	stems: Compulsory	
	General Engineering Science (English program, 7 semeste	r): Specialisation Naval Architecture: Compulsor	у	
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical Engineering, Focu	s Energy Systems: E	elective Compulsory
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science	e: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Science	e: Elective 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	
	<ul> <li>3. Computation of potential flows</li> <li>4. Introduction of finite-differences</li> <li>5. Approximation of convective, diffusive and transient transport processes</li> </ul>	
	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: Fundamen	tals of Ship Structural Design and Analysis			
Courses				
		T	Herefole	0.0
Title	(244)	Тур	Hrs/wk	CP
Fundamentals of Ship Structural Design (I Fundamentals of Ship Structural Design (I		Lecture Recitation Section (small)	2	2
Fundamentals of Ship Structural Analysis		Lecture	2	2
Fundamentals of Ship Structural Analysis		Recitation Section (small)	1	2
Module Responsible		······································	•	
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
	100			
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 beha	viour of ship structures; they can explain	n the theory and meth	ods for the calculation
	deformations and stresses in beam-like structures.			
	Furthermore, they can reproduce the basis contents of codes (r	ules) materials semi-finished products	ioining and principle	es of structural design
	components in the ship structure.	aree), materiale, com imerica products	, joining and principle	o o o o o o o o o o o o o o o o o o o
	components in the strip structure.			
Chille				
Skilis	Students are capable of applying the methods and tools for the c	alculation of linear deformations and str	esses in the above in	lentioned structures; the
	can choose calculation models of typical ship structures.			
	Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they can select suitable materials, semi-finished products			
	and joints.			
Personal Competence				
Social Competence	The students are able to communicate and cooperate in a profess	ional environment in the shipbuilding an	d component supply i	ndustry.
,				,
Autonomy	The students are capable to independently idealize real ship st	ructures and to select suitable methods	for analysis of beam	n-like structures; they ar
	capable to assess the results of structural analyses.			
	Furthermore, they are capable to assess drawings of complex	ship structures and to design ship struc	ctures for various req	uirements and boundar
	conditions.	, and the state of the state of the state		
Workload in Hours	Independent Study Time 156 Study Time in Lecture 94			
	, , , ,			
Credit points				
	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation I			
Curricula	General Engineering Science (German program, 7 semester): Spi	·	ory	
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program, 7 semester): Spe	cialisation Naval Architecture: Compulso	ory	
	Naval Architecture: Core qualification: 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	citation Section (small)	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	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 I	Design and Construction of Ships			
Courses				
Title		Тур	Hrs/wk	CP
Ship Structural Design (L0412)		Lecture	2	3
Ship Structural Design (L0415)		Recitation Section (small)	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students can reproduce design and sizing as well as fabrication they can describe calculation models for complex structures.	n of the different areas of ship structures	and of different ship ty	/pes (incl. detail design)
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for the components, to select suitable calculation models and to assess the chosen structure			
Personal Competence Social Competence	Students are capable to present their structural design and discu	ss their decisions constructively in a grou	p.	
Autonomy	Students are capable to design independently different structure methods.	al areas of the ship hull and different sl	nip types and to defin	e appropriate 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): Specialisation	Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Sp		sory	
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Compuls	ory	
	Naval Architecture: Core qualification: 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:	
Literature	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		
•	Recitation Section (small)	
Hrs/wk		
СР		
	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.	



Module M1118: Hydrostation	s 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 Mechanic	cs I-III.		
Knowledge	It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan, GA- Plan, Tank Plan etc.			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge				
	all following lectures in the subjects shipo design ar	nd safety of ships.		
0.111				
Skills	The student is able to carry out hydrostatic calculation	ons to ensure that the ship has sufficient stability. He	is able to design hull to	orms that are sate again
	capsizing or sinking.			
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	180 min			
Assignment for the Following	General Engineering Science (German program): S	pecialisation Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 s	semester): Specialisation Naval Architecture: Compul	sory	
	General Engineering Science (English program): Sp	pecialisation Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 s	emester): Specialisation Naval Architecture: Compuls	sory	
	Naval Architecture: Core qualification: Compulsory			

Course L1260: Hydrostatics	Lastina	
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	
	[164]	



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

Literature 1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig



2. Henschke
Schiffstechnisches Handbuch, Band 1
VEB Technik Verlag Berlin

3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

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

Course L1452: Body Plan		
Тур	Project Seminar	
Hrs/wk	2	
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 M1109: Resistance	and Propulsion			
Courses				
Title		Тур	Hrs/wk	CP
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Made			
Knowledge	Mechanics			
	Fluid Dynamics for Naval Architects			
	Hydrostratics			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for resistance and pr	opulsion of ships are discussed. The diffe	erent resistance pheno	mena and their practica
	applications to hullform design as well as numerical and empiri	cal prediction methods are subject of the	course. Furthermore,	environmental additiona
	resistances are dealt with. The course includes model test to	chniques and their application to full s	cale ships. This hold	also for propulsion and
	hullefficiency elements, mainly thrust deduction and wake. I	Main Focus is how hull forms can be	optimized for minimu	m 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, thrust			
	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 s	tate), EEDI, speed trials, contractual matte	ers concerning speed/p	oower, bunker claims
Skills	In the student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls			
Onno	by several progosis methods. Furtermore, the course will of		·	
	environmental influences.	made the stadent to steam determine	und minimize the re	quired power incidum
	environmental mildences.			
Personal Competence				
Social Competence	The student learns to prepare technical matters in such a way the	at he can compte with his building suvervi	sion team.	
Autonomy	The student learns to prepare technical matters in such a way the	at he can compte with his building suvervi	sion 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		
Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architecture: Compuls	sory	
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Compuls	ory	
	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 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 M1110: Ship Desig	n			
Courses				
Title		Тур	Hrs/wk	CP
Ship Design (L1262)		Lecture	2	3
Ship Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Fluid Dynamics for Naval Architects, Resistance and Propul	sion		
Knowledge	Resistance and Propulsion, Hydrostatics			
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the importance and re	equirements of the aerly design pha	se. Competitive Elemen	nts of Ship Designs are
	thoroughly discussed. Typical bulding contracts and the related	technical risk are introduced. The	most important main pa	rameters of a ship are
	introduced and their influence on the competitiveness of a design	n. The lecture focusses on the influe	ence of alternated main	parameters on the total
	performance of a ship design and the consecutive process eleme	nts. In this lecture, the design chang	es are dealt with by sim	ple models or formulae.
	The student shall further learn to model complex systems properly	so that the relavent technical conclusion	ons can be drawn.	
	The lecture continues with an introduction into the different phases	of design project, from the initial desig	n phase to a building co	ontract. Further, methods
	are introduced to generate bulding specfication relevant informat	ion at different levens of granularity	during the different desi	gn stages. In detail, the
	following topics are adressed:			
	- 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 s	eagoing mearchant ships. The goal o	of the lecture is that the	student shall be able to
	carry out a concept design based on a vessel of comparison fulfillir	ng typical contract requirements within	the Marine Environmer	t. The lecture deals with
	the basic design methods to determine the fundamantal technical	characteristics of a ship design with	respect to fulfillment pro	ocedures of the contract
	values. Based on the lecture "Principles of Ship Design" the relevan	nt methods to determine and judge up	pn the performance of a	ship design are treated.
Personal Competence				
-	The students learns to prepare technical matters in such a way the	he can persuade his potantial custom	er against his competito	rs.
· ·	The students learns to prepare technical matters in such a way the			
Workload in Hours  Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation N	aval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spec		lsory	
	General Engineering Science (English program): Specialisation Na	•		
	General Engineering Science (English program, 7 semester): Spec		sory	
	Naval Architecture: Core qualification: Compulsory			

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.

Module M0886: Fundamen	tals of Process Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Introduction into Process Engineering/Biop	process Engineering (L0829)	Lecture	2	1
Fundamentals of material engineering (L0	330)	Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	After passing this module the students have the ability to:			
	• give an even joy of the most important fields an arr	acces and highways anginessing		
	give an overview of the most important fields on pro     overlain come working methods for different fields in			
	<ul> <li>explain some working methods for different fields in</li> </ul>	r process engineering.		
Skills	After passing this module the students should have the abi	lity to:		
	<ul> <li>list and outline the most important fields of process</li> </ul>	engineering.		
	name the most important working approaches or m	-	neering.	
	<ul> <li>read and prepare an engineering drawing,</li> </ul>	3	3,	
	explain the most important technologies for wastew	rater and exhaust air treatment		
	scheme typical chemical and biotechnological prod		S.	
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.		
Autonomy	The students are able to estimate their progress of lear	ning by themselves and to deliberate their	r lack of knowledge in P	rocess Engineering and
. id.onomy	Bioprocess Engineering.	5 -,	ccago III I	and and and and
	, , , , , , , , , , , , , , , , , , , ,			
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): Speciali	sation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speciali			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 semest	er): Specialisation Bioprocess Engineering:	Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis	, , ,		
	General Engineering Science (English program): Specialis	sation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	er): Specialisation Bioprocess Engineering:	Compulsory	
	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	a Chiallo
Literature	s. Studie

Course L0830: Fundamentals of ma	iterial engineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	<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				
Title		Тур	Hrs/wk	CP
Physical Chemistry (L0833) Physical Chemistry (L0835)		Lecture Laboratory Course	2	2
Module Responsible	Prof. Hans-Ulrich Moritz	Laboratory Godrse	2	ı
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemistry, physics for	onginoers and mathematics I III		
Knowledge	Contents of the previous modules morganic chemistry, physics for	engineers and mathematics i-iii.		
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	Alter taking part successibility, students have reached the following	rearring results		
Knowledge	The students are able,			
Mowieage	The statement are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-, he	at- and momentum transfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.			
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and ki	netic calculations.		
	- assess new applications with respect to environmental sustaina	bility.		
	- abstract their knowldege to related issues to conduct thermodyna	amical, electrochemical and kinetic ca	Iculations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document ex	periments according to scientific guide	elines in small groups.	
	The students are able to reflect their subject-specific knowledge o	rally 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 their	r 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	General Engineering Science (German program): Specialisation I			
Curricula	General Engineering Science (German program): Specialisation I		nnulaan	
	General Engineering Science (German program, 7 semester): Spo General Engineering Science (German program, 7 semester): Spo			
	Bioprocess Engineering: Core qualification: Elective Compulsory	onangation bioprocess Engineering. E	_iocave Compusory	
	General Engineering Science (English program): Specialisation P	rocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation B			
	General Engineering Science (English program, 7 semester): Spe		npulsorv	
	General Engineering Science (English program, 7 semester): Spe			
	Process Engineering: Core qualification: Compulsory			
	2 2 4aara aaka.aa)			

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	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>



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
Cycle	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
	Reaction kinetics
	Freezing-point depression (cryoscopy)
	Electrical mobility of ions
	Viscosimetry
	Heat of neutralization
	Surface tension
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Module M0536: Fundament	als of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
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:			
	a cyploin the difference between different types of fle			
	<ul> <li>explain the difference between different types of flo</li> <li>give an overview for different applications of the Re</li> </ul>		rina	
	explain simplifications of the Continuity- and Navie		-	
Skills	The students are able to			
	describe and model incompressible flows mathematical	atically		
	<ul> <li>reduce the governing equations of fluid mechanics</li> </ul>	by simplifications to archive quantitative solution	ons e.g. by integration	
	notice the dependency between theory and technic			
	<ul> <li>use the learned basics for fluid dynamical applicati</li> </ul>	ons in fields of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from subject relationships and are capable to gather information from subject relationships.	ted, professional publications and relate that int	ormation to the contex	t of the lecture and
	able to work together on subject related tasks in sn			
	exercises)			
	are able to work out solutions for exercises by them	nselves, to discuss the solutions orally and to pr	esent the results.	
Autonomy	The students are able to			
,				
	search further literature for each topic and to expan			
	<ul> <li>work on their exercises by their own and to evaluat</li> </ul>	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			
Curricula	General Engineering Science (German program): Speciali		2	
	General Engineering Science (German program): Speciali General Engineering Science (German program, 7 semes	0,	. ,	
	General Engineering Science (German program, 7 semes	, ,	•	
	General Engineering Science (German program, 7 semes			ry
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification	n: Compulsory		
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis	**	Compulsory	
	General Engineering Science (English program 7 semest	0 0 1 ,	uleory	
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 semestration of the semestration of the semestration of the semestration of the semistration of th			у
	Technomathematics: Specialisation III. Engineering Science			-
	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>

	Process Engineering
**	
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example
	tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed
	with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct
	solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-
	frame in small groups and discuss the solutions afterwards.
Literature	Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
	Crowe, C. 1. Engineering hald mechanics. whey, New York, 2009.     Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
	2. Durst, F., Stromangsmedianik. Eliminang in the Theorie der Stromangen von Hulden. Springer-verlag, Berlin, Heidelberg, 2006.  3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
	4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin,
	Heidelberg, New York, 2006
	5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH,
	Wiesbaden, 2008
	6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
	7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV
	Fachverlage GmbH, Wiesbaden, 2009
	8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
	9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, 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 M0544: Phase Equ	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, Thermodynamics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	• Starting from the very begins of thermodynamics, the s	tudents learn the mathematical tools to descri	iha tharmadunamia a	wilibrio
	Starting from the very basics of thermodynamics, the starting from the very basics of thermodynamics, the starting from the very basics of thermodynamics.			
	They learn how state variables are influenced by the n			
	Moreover, the students learn how phase equilibria can		enomena may occur i	t different phases (vapor
	liquid, solid) coexist in equilibrium. Furthermore the fur			
	For different phase equilibria, several examples releva-	ant for different kinds of processes are shown	and the necessary ki	nowledge for plotting and
	interpreting the equilibria are taught.			
Skills				
	<ul> <li>Applying their knowledge, the students are able to id</li> </ul>	lentify the correct equation for the determina	tion of the equilibriur	n state and know how to
	simplify these equations meaningfully.			
	<ul> <li>The students know models which can be used to det</li> </ul>	ermine the properties of the system in the ed	quilibrium state and t	ney are able to solve the
	resulting mathematical relations.			
	<ul> <li>For specific applications, they are able to self-reliantly</li> </ul>	find necessary physico-chemical properties	of compounds as wel	l as model parameters in
	literature sources.			
	Beside pure compound properties the students are ca	pable of describing the properties of mixtures	i.	
	<ul> <li>The students know how to visualize phase equilibria g</li> </ul>	raphically and they know how to interpret the	occurring phenomen	a.
	Based on their knowledge, the students are able to	understand fundamental concepts that are	the basis for many	separation and reaction
	processes in chemical engineering.			
Porconal Compatance				
Personal Competence	The students are able to work in and I was a second as a second as	reconnecting problems and to average the	roly to the tritere as a large	ther etudents
Social Competence	The students are able to work in small groups, to solve the cor	rresponding problems and to present them or	aly to the tutors and o	urier students
Autonomy	The students are able to find necessary information se	If-reliantly in literature sources and to judge the	heir quality.	
	During the semester the students are able to check th			wledge the students car
	adept their learning process.	5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -		
	230pt tron roanning provides			
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): Specialisati	0 0 1 ,		
Curricula	General Engineering Science (German program): Specialisati	ion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester)	: Specialisation Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Bioprocess Engineering: Cor	npulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester):		Isorv	
	General Engineering Science (English program, 7 semester):		•	
	Process Engineering: Core qualification: Compulsory		,	



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. G <sup>E</sup> -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>	



urses	Typ Hrs/wk CP
	Typ Hrs/wk CP  Lecture 3 4
nals and Systems (L0432) nals and Systems (L0433)	Recitation Section (large) 1 2
	Prof. Gerhard Bauch
	None
·	Mathematics 1-3
Knowledge	indulcinduos 1-0
Knowedge	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	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 as
	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 le
,	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
	6
·	Written exam
	90 min
-	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: Compul
	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 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 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 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 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
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Engray 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 Materials in Engineering Science
	Compulsory
1	
	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



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 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 M0757: Biochemist	try and Microbiology			
Courses				
Title		Тур	Hrs/wk	CP
Biochemistry (L0351)		Lecture	2	2
Biochemistry (L0728)		Problem-based Learning	1	1
Microbiology (L0881)		Lecture	2	2
Microbiology (L0888)		Problem-based Learning	1	1
Module Responsible	Dr. Paul Bubenheim			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learn	ning results		
Professional Competence				
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical research to determ	nine the properties of biomolecules		
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Skills				
Personal Competence				
Social Competence	The students are able,			
	- to gather knowledge in groups of about 10 students			
	- to introduce their own knowledge and to argue their view in discussion	ns in teams		
	- to divide a complex task into subtasks, solve these and to present the	combined results		
Autonomy	The students are able to present the results of their subtasks in a written	n 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): Specialisation Biopro	ocess Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialis	sation Bioprocess Engineering: Cor	mpulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Biopro	cess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialis	sation Bioprocess Engineering: Con	npulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective C	Compulsory		



Course L0351: Biochemistry	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	
	The molecular logic of Life
	2. Biomolecules:
	Amino acids, peptides, proteins
	2. Carbohydrates
	Lipids     Protein functions, Enzymes:
	Protein functions, Enzymes:     1. Michaelis-Menten kinetics
	Nichaelis-Menten kinetics     Enzyme regulation
	3. Enzyme nomenclature
	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
	p

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

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



courses				
itle		Тур	Hrs/wk	CP
troduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	3	3 3
Module Responsible	Prof. Christoph Ihl	1 Tobletti-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	learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of m. Marketing and Innovation, and also to Investment and Controlling.		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Managem	ent and 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 Manage     describe and explain basic business functions as product			
	ressource management, information management, innovati		chain management,	organization and num
	explain the relevance of planning and decision making in		Iltiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected cont	rolling methods.		
Skills	Students are able to analyse business units with respect to Entrepreneurship project in a team. In particular, they are able to	different criteria (organization, object	ctives, strategies etc	.) and to carry out
	analyse Management goals and structure them environments	lv.		
	analyse Management goals and structure them appropriate     analyse organisational and staff structures of companies	ny .		
	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 controlling.	ng 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 entrepreneu	rship 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 Minuten			
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			
	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program): Specialisation C General Engineering Science (German program): Specialisation N		mpulsory	
	General Engineering Science (German program): Specialisation B			
	General Engineering Science (German program): Specialisation N	aval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Spe	cialisation Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Spe	cialisation Process Engineering: Compu	ılsory	
	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			у
	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, Foo	cus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Foc cialisation Mechanical Engineering, Foc	cus Biomechanics: Co cus Aircraft Systems E	mpulsory ngineering: Compulso
	General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Compulsory	cialisation Mechanical Engineering, Foo cialisation Mechanical Engineering, Foo Specialisation Mechanical Engineering	cus Biomechanics: Co cus Aircraft Systems E g, Focus Materials in	mpulsory ngineering: Compulso n Engineering Science
	General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester):	cialisation Mechanical Engineering, Foo cialisation Mechanical Engineering, Foo Specialisation Mechanical Engineering	cus Biomechanics: Co cus Aircraft Systems E g, Focus Materials in	mpulsory ngineering: Compulso n Engineering Science



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

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

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

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. 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 Managemen 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
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 M0938: Bioprocess	Engineering - Fundamentals			
Courses				
Title		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (	1.0841)	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 proce	ess engineering"		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to describe the basic concepts of bioprocess microorganisms, as well as to differentiate different types of inhibit processes in bioreactors can be explained. The students are called downstream processing in detail.	tion. The parameters of stoichiometry ar apable to explain fundamental bioproce	nd rheology can be na	amed and mass transp
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 then 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 de own opinions and increase their capacity for teamwork in enginee After completion of this module participants will be able to solve present their results in a plenum.	ring and scientific environments.		
Waydaad in Hawa	Independent Chada Time OC Chada Time in Leebar O4			
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 F			
Curricula	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program, 7 semester): Spe	0 0 1	,	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Bioprocess Engineering: Cor	npulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation B			
	General Engineering Science (English program): Specialisation P			
	General Engineering Science (English program, 7 semester): Spe	·	-	
	General Engineering Science (English program, 7 semester): Spe		npulsory	
	Biomedical Engineering: Specialisation Artificial Organs and Rege	• •		
	Biomedical Engineering: Specialisation Implants and Endoprosthe			
	Biomedical Engineering: Specialisation Medical Technology and	, , ,		
	Biomedical Engineering: Specialisation Management and Busines			
	Technomathematics: Specialisation III. Engineering Science: Elec	ive 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
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	1. Introduction (Prof. Liese, Prof. Zeng)
	2. Enzymatic kinetics (Prof. Liese)
	3. Stoichiometry I + II (Prof. Liese)
	4. Microbial Kinetics I+II (Prof. Zeng)
	5. Rheology (Prof. Liese)
	6. Mass transfer in bioprocess (Prof. Zeng)
	7. Continuous culture (Chemostat) (Prof. Zeng)
	8. Sterilisation (Prof. Zeng)
	9. Downstream processing (Prof. Liese)
	10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)
Literature	siehe Vorlesung

Course L0843: Bioprocess 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	Typ Hrs/wk CP
Heat and Mass Transfer (L0101)	Lecture 2 4
Heat and Mass Transfer (L0102)	Recitation Section (small) 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 and determining quantitative heat transfer in procedural apparatus (e. g. heat exchange).
	chemical reactors).
	They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and therm
	radiation.
	The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative learning.
	using suitable mass transfer theories.
	They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.
	They are able to depict the analogy between hear and mass transfer and to describe complex linked processes in detail.
Skills	
Okins	The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the students.
	corresponding energy and mass flow, respectively.
	They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the solution of the solution
	corresponding heat flows.
	Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.
	They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description
	and design of apparatus (e.g. extraction column, rectification column).
	<ul> <li>In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application.</li> </ul>
	considering their advantages and disadvantages, respectively.
	<ul> <li>In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.</li> </ul>
	The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the course the course of the
	thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.
Personal Competence	
Social Competence	The students are combile to used an authorst except the security and to present the results are all times and to present the results are all times and the present the results are all times are all t
	The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors at the set death.
	other students.
Autonomy	The ship death are ship to find and applications information from a simple control
	The students are able to find and evaluate necessary information from suitable sources
	They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-lil)
	assignments) and on this basis they can control their learning processes.
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Examination	
	1
Examination duration and scale	120 minutes: theoretical questions and calculations
Examination duration and scale	
Assignment for the Following	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
Assignment for the Following	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
Assignment for the Following	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
Assignment for the Following	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
Assignment for the Following	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 General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Assignment for the Following	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 General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Assignment for the Following	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 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: Compulsory
Assignment for the Following	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 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: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the Following	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 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: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
Assignment for the Following	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 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: 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: Compulsory
Assignment for the Following	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 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: 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: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory
Assignment for the Following	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 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: 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: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
Assignment for the Following	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 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: 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: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory
Assignment for the Following	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 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: 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: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
Assignment for the Following	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 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: 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: 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
Assignment for the Following	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 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: 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: 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 Bioprocess Engineering: Compulsory



Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, 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	ecitation Section (small)		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	Heat transfer		
	Introduction, one-dimensional heat conduction  Convective heat transfer  Multidimensional heat conduction  Non-steady heat conduction  Thermal radiation  Mass transfer  one-way diffusion, equimolar countercurrent diffusion  boundary layer theory, non-steady mass transfer  Heat and mass transfer single particle/ fixed bed  Mass transfer and chemical reactions  The students work on tasks in small groups and present their results in front of all students.		
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer     VDI-Wärmeatlas		



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)	I	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 separations.	concentration during a separation proces n 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 grou  The students are able to carry out practical lab work in small groups.			n them. They are able to
	discuss their results and to document them scientifically in		5.011 01 Id201 2011100	in anomi. They are able to
	,			
Autonomy	The students are capable to obtain the needed information The students can proof the state of their knowledge with ex	•	, ,	ing process
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
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 F	Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program): Specialisation E	nergy and Enviromental Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester): Spe	cialisation Process Engineering: Compul	sory	
	General Engineering Science (German program, 7 semester): Spe	cialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (German program, 7 semester): Spe	cialisation Energy and Enviromental Eng	ineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): Specialisation B	ioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation E	nergy and Enviromental Engineering: Cor	mpulsory	
	General Engineering Science (English program): Specialisation P	rocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe	cialisation Energy and Enviromental Engi	neering: Compulsory	′
	Process Engineering: Core qualification: Compulsory			



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
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	1
Workload in Hours	Independent Study Time 2, 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	I		
Workload in Hours	ndependent 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	98		
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 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		
	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.  R. Goedecke (Hrsg.): A control of the co		
	Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s  For Many day Tarker and Chemical Community  The Many Description of the Chemical Commu		
	Enzyklopädie der Technischen Chemie		
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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 isothermal and non-isothermal ideal reactors,			
	- determine and compute stable operation points for these 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 students have a strong ability to organize themselfes in small groups to solve issues in chemical			
	reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers.			
Autonomy	The students are able to obtain further information and	assess their relevance autonomously. 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 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
- $R.\ Aris, Elementary\ Chemical\ Reactor\ Analysis, Dover\ Pubn.\ Inc., 2000$
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- $\hbox{G.\,F. Froment, K.\,B.\,Bischoff, J.\,De\,\,Wilde,\,Chemical\,\,Reactor\,\,Analysis\,\,and\,\,Design,\,John\,\,Wiley\,\,\&\,\,Sons,\,2010}$
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, produc
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conselectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficien dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, sheat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, of equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction med microkinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy a exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible resequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenst limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic 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 fo kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - preactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, des membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivi balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical anal cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic ex reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-istreactors, optimum temperature profile of a reactor)
Literature	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



Course L0221: Experimental Course	e 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)		



Courses				
itle		Тур	Hrs/wk	CP
ioprocess Engineering - Advanced (L110	07)	Lecture	2	4
ioprocess Engineering - Advanced (L110	98)	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 follo	wing learning results		
Professional Competence				
Knowledge	After successful completion of this module, students should be	e able to		
	<ul> <li>describe and explain different kinetic approaches for g</li> </ul>	rowth and substrate-uptake		
		•		
	identification of scientific problems with concrete indu	strial use (cultivation of microorganisms and r	mammalian cells)	
	<ul> <li>describe and explain important downstreaming steps</li> </ul>	for proteins and their application as well as b	asic immobilization n	ethods
Skills	After successful completion of this module, students should be	e able to		
	- to identifiy scientific questions or possible practical probler	ns for concrete industrial applications (eg cu	Itivation of microorga	nisms and animal cell
	and to formulate solutions,	солосто подата предостава (од от		
	- To assess the application of scale-up criteria for different type	pes of bioreactors and processes and to appl	y these criteria to giv	en problems (anaerob
	aerobic or microaerobically)			
	- to formulate questions for the analysis and optimization of re	al biotechnological production processes app	propriate solutions,	
	- To describe the effects of the energy generation, the regeneration of reduction equivalents , and the growth inhibition of the behavior of microorganisms			
	and to the total fermentation process qualitatively			
	- Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and to calculate immobilization			
	and activity yields ,			
	- to select process control strategies (batch , fed-batch , contin	uity) appropriately and to calculate basic typ	es and evaluate ther	٦.
Personal Competence				
Social Competence	After completion of this module participants should be able	o 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 aquir	e new sources of knowledge and apply their	knowledge to previou	usly 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): Specialisat	ion Bioprocess Engineerina: Compulsorv		
Curricula	General Engineering Science (German program, 7 semester)		npulsory	
	Bioprocess Engineering: Core qualification: Compulsory	,		
	General Engineering Science (English program): Specialisati	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):		pulsory	
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective 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	
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			
wodule woods. Process an	a Flant Engineening 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 I	earning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical proces	ses		
	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 c	omponent balance models		
	- solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of productio	n 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 Pr	ocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bi	oprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Spec	ialisation Process Engineering: Compu	lsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Bioprocess Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Energy and Enviromental Eng	gineering: Elective Co	mpulsory
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bio	process Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Program	cess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spec	alisation Process Engineering: Compu	Isory	
	General Engineering Science (English program, 7 semester): Spec	alisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): Spec	alisation Energy and Enviromental Eng	ineering: Elective Co	mpulsory
	Process Engineering: Core qualification: Compulsory			

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



Data reconciliation and data validation	n
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## 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, Chem. -Ing.-Tech. 72(2000)Nr. 10, S.1157

E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997

M. H. Bauer, J. Stichlmair, Chem.-Ing.-Tech., 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

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G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213

G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133

U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000

J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991

T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001

 $G.\ Gruhn,\ Vorlesungsmanuskript\ "Prozess-\ und\ Anlagentechnik,\ TU\ Hamburg-Harburg$ 

D. Hairston, Chemical Engineering, October 2001, S. 31-37

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J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511

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				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	• name and explain pressures and unit an explain of callid	nracca anginaering		
	<ul> <li>name and explain processes and unit-operations of solids</li> <li>characterize particles, particle distributions and to discuss</li> </ul>			
	Characterize particles, particle distributions and to discuss	trieff bulk properties		
Skille	Students are able to			
Skills	Students are able to			
	<ul> <li>choose and design apparatuses and processes for solids</li> </ul>	processing according to the desired soli	ds properties of the pro	duct
	<ul> <li>asses solids with respect to their behavior in solids proces</li> </ul>	sing 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			
Coolai Competence	a group.			
Autonomy	a group.			
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 F	Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation I			
, , , , , , , , , , , , , , , , , , , ,	General Engineering Science (German program): Specialisation I		Compulsory	
	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 E	ioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation E	nergy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (English program): Specialisation F	rocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spe	cialisation Process Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Bioprocess Engineering: Co	mpulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Energy and Enviromental En	gineering: Compulsory	1
	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	
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	learning results			
<b>Professional Competence</b>					
Knowledge	Students are able to explain the basic methods for calculating of periodic signals. They know the methods for transient analysis of frequency behaviour and the synthesis of passive two-terminal-circ	of linear networks in time and in frequen			
Skills	The students are able to calculate currents and voltages in linear able to calculate transients in electrical circuits in time and frequent analyse and to synthesize the frequency behaviour of passive two	ncy domain and are able to explain the re			
Personal Competence					
Social Competence	Students work on exercise tasks in small guided groups. They are	encouraged to present and discuss their	results within the gro	up.	
Autonomy	The students are able to find out the required methods for solving lectures continuously by means of short-time tests. This allows t knowledge to other courses like Electrical Engineering I and Math	hem 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): Specialisation E	Electrical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisation		nics: Compulsory		
	General Engineering Science (German program, 7 semester): Spe			npulsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Electrical Engineering: Comp	ulsory		
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation M	dechanical Engineering, Focus Mechatro	nics: Compulsory		
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering, Foci	us Mechatronics: Con	npulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Electrical Engineering: Comp	ulsory		
	Computational Science and Engineering: Specialisation Engineer	ring Sciences: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: Elec				
	Technomathematics: Specialisation III. Engineering Science: Elec	tive 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	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 M0567: Theoretica	l Electrical Engineering I: Time-Independen	t Fields			
Courses					
Title		Тур	Hi	rs/wk	СР
Theoretical Electrical Engineering I: Time-	Independent Fields (L0180)	Lecture	3		5
Theoretical Electrical Engineering I: Time-	Independent Fields (L0181)	Recitation Section (sm	all) 2		1
Module Responsible	Prof. Christian Schuster				
Admission Requirements	Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathemati	k II, Mathematik III			
Recommended Previous Knowledge	Basic principles of electrical engineering and advanced m	athematics			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results			
Professional Competence					
Knowledge Skills	Students can explain the fundamental formulas, relations, and methods of the theory of time-independent electromagnetic fields. They can explicate the principal behavior of electrostatic, magnetostatic, and current density fields with regard to respective sources. They can describe the properties complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time independent electromagnetic fields and are able to explicate these.  Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independent, electromagnetic field problem				
	Furthermore, they are capable of applying a variety of me assess the principal effects of given time-independent sou characterization of electrostatic, magnetostatic, and electrothem for practical applications.	urces of fields and analyze these quan	titatively. They can c	deduce mear	ningful quantities for th
Personal Competence					
Social Competence	Students are able to work together on subject related to sessions).	asks in small groups. They are able	to present their resu	ults effective	ly (e.g. during exercis
Autonomy	Students are capable to gather necessary information from reflect their knowledge by means of activities that accompand the exam. Based on respective feedback, students are examtheir knowledge obtained in this lecture and the content of	any the lecture, such as short oral quiz pected to adjust their individual learni	zzes during the lectung process. They are	res and exer e able to dra	rcises that are related w connections between
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				
Examination duration and scale  Assignment for the Following	90-150 minutes  General Engineering Science (German program): Special	isation Electrical Engineering: Compul	sory		
		0 0 1	•		
Assignment for the Following	General Engineering Science (German program): Special	0 0 1	•		
Assignment for the Following	General Engineering Science (German program): Special General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Engineer	ing: Compulsory		
Assignment for the Following	General Engineering Science (German program): Special General Engineering Science (German program, 7 semes Electrical Engineering: Core qualification: Compulsory	ter): Specialisation Electrical Engineer	ing: Compulsory		



New	Course L0180: Theoretical Electrical	al Engineering I: Time-Independent Fields
Workload in Hours Lecturer Language DE Cycle SoSe Content	Тур	Lecture
Independent Study Time 108, Study Time in Lecture 42	Hrs/wk	3
Leaguage DE  Cycle SoSe  Content - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems  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", Mograw-Hill (2013)	СР	5
Language  Oycle SoSes 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 Feldter: Theorie und Anwendung", Springer (2011) - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) - U. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) - J. Edminister, "Schaum's Outline of Electromagnetics", Mograw-Hill (2013)	Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
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 (2011)  - 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", Mograw-Hill (2013)	Lecturer	
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 Feldtheorie: 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", Mograw-Hill (2013)		
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  - 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", Mograw-Hill (2013)	· · · · · · · · · · · · · · · · · · ·	
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		- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)		- 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	l 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
	DE
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
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	- 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	СР
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 following	g learning results		
Professional Competence				
Knowledge	Students can explain the composition and the structural properti	es of materials used in electrical engine	eering. Students can e	xplicate the relevance of
	mechanical, electrical, thermal, dielectric, magnetic and chemical	properties of materials in view of their a	pplications in electrical	engineering.
01.71	Objects and Stanffer and a second standards and a second standards	to the constitution of all to The constitution		None and Soder Codes
Skills	Students can identify appropriate descriptive models and app		ive approximative soil	itions and judge factors
	influential on the performance of materials in electrical engineering	ig applications.		
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups.	They can present their results effective	ly within the framework	k of the problem solving
	course.			
4.4	Ot the beautiful to the	and the discrete section and the section that the factor		of the lead on Theorem
Autonomy	Students are capable to extract relevant information from the pro-			•
	reflect their acquired level of expertise with the help of lecture	accompanying measures such as exam	n typicai exam questio	ns. Students are able to
	connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Sp		pulsory	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Electrical Engineering: Core qualification: Compulsory	3 : 3 · · · · · · · · · · · · · · · · ·	. ,	
	General Engineering Science (English program): Specialisation I	Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spo		pulsory	
	Computational Science and Engineering: Specialisation Enginee			
	Computational Science and Engineering: Specialisation Engineer	ring Sciences: Elective Compulsory		



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



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	
	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator.
Content	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
	13.Wikipedia, Wikimedia
	10.Thispoola, Thishloola



Course L0687: Materials in Electrica	al 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	Tvp 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
Recommended Previous	Mathematics 1-3
Knowledge	indirection of the state of the
	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
	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain will be a supported by the control of
	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 theorems.
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, 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.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the
	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
Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Process 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: Com
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering S
	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, Focus Theoretical Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering: Core qualification: Compulsory  General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: 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 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 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: Comparison of the Comp
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering S
	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 Mechanical Compulsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engi
l l	
	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	ndependent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Gerhard Bauch DE/EN	
Language		
Content	Basic classification and description of continuous-time and discrete-time signals and systems	
	Concvolution	
	Power and energy of signals	
	Correlation functions of deterministic signals	
	Linear time-invariant (LTI) systems	
	Signal transformations:	
	Fourier-Series	
	Fourier Transform	
	Laplace Transform	
	Discrete-time Fourier Transform	
	Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)	
	• Z-Transform	
	Analysis and design of LTI systems in time and frequency domain	
	Basic filter types	
	Sampling, sampling 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 M0709: Electrical E	ngineering IV: Transmission Lines and	Research Seminar		
Courses				
Title		Тур	Hrs/wk	CP
Research Seminar Electrical Engineering, Transmission Line Theory (L0570)	Computer Science, Mathematics (LU5/1)	Seminar Lecture	2	2
Transmission Line Theory (L0570)		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 reached the	ne following learning results		
Professional Competence				
Knowledge	Students can explain the fundamentals of wave prop	agation on transmission lines at low and high fre	quencies. They are ab	le to analyze circuits with
	transmission lines in time and frequency domain. The	ey can describe simple equivalent circuits of tran	smission lines. They a	re able to solve problems
	with coupled transmission lines. They can present and	discuss a self-chosen research topic.		
Skills	Students can analyze and calculate the propagation	of waves in simple circuits with transmission line	s. They are able to ana	alyze circuits in frequency
	domain and with the Smith chart. They can analyze	e equivalent circuits of transmission lines. They	are able to solve pro	blems including coupled
	transmission lines using the vectorial transmission line	e equations. They are able to give a talk to profess	ionals.	
Personal Competence				
Social Competence	Students can analyze and solve problems in small g	roups and discuss their solutions. They can com	pare the learned theor	y with experiments in the
•	lecture and discuss it in small groups. They are able to	·		,
Autonomy	The students can solve problems by their own and a	re able to acquire skills from the lecture and the	literature. They are ab	le to test their knowledge
ricionomy	using computer animations. They can test their level o	·	•	-
	acquired knowledge to other lectures (e.g. Electrical			
	can prepare a presentation.			
	, ,			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 ser	mester): Specialisation Electrical Engineering: Co	mpulsory	
	Electrical Engineering: Core qualification: Compulsory	,		
	General Engineering Science (English program): Spec	cialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 ser	nester): Specialisation Electrical Engineering: Cor	npulsory	
	Computational Science and Engineering: Specialisation	on Engineering Sciences: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Sc	sience: Elective Compulsory		
	Technomathematics: Core qualification: Elective Com	pulsory		

Course L0571: Research Seminar Electrical Engineering, Computer Science, Mathematics	
Тур	Seminar
Hrs/wk	2
СР	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 (	L0640)	Laboratory Course	5	6
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I, Electrical Engineering II			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technic			
	are capable of describing and communicating rele process of solving practical problems and present re	evant problems and questions using appropriate to	echnical language. The	y can explain the typical
	process of solving practical problems and present in	erated results.		
Skills	The students can transfer their fundamental know	vledge on electrical engineering to the process of	of solving practical prob	olems. They identify and
•		projects in the context of electrical engineering. Stu		
	conceptual solutions for non-standardized problems	5.		
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-sub-			
		nd explain their results alone or in groups in front of	•	•
	develop alternative approaches to an electrical eng	ineering problem independently or in groups and di	scuss advantages as we	ell as drawbacks.
Autonomy	Students are concluded independently coluing also	ptrical analogoring problems using provided literate	ura. Thay are able to fill	anno in an well an extent
Autonomy	Students are capable of independently solving ele-	urces provided by the supervisor. Furthermore, the	•	
	pragmatically solve them by means of corresponding		y dan maamigiany ox	ona givon probleme and
	,	-		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Project			
Examination duration and scale	based on task + presentation			
Assignment for the Following	General Engineering Science (German program): S			
Curricula		semester): Specialisation Electrical Engineering: Co	mpulsory	
	Electrical Engineering: Core qualification: Compuls			
	General Engineering Science (English program): Speneral Engineering Science (English program, 7 speneral Engineering Science (English program)	pecialisation Electrical Engineering: Compulsory semester): Specialisation Electrical Engineering: Co	mnulsory	
	Technomathematics: Specialisation III. Engineering		пригосту	
	Technomathematics: Ore qualification: Elective Co			
		. ,		

Course L0640: Electrical Engineering	ng 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 completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).



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	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)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements Recommended Previous	none Mathematics 1 - III			
Knowledge	Wallefflatics 1 - III			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Mathema	tics IV. They are able to explain them using appr	opriate examples.	
	<ul> <li>Students can discuss logical connections between</li> </ul>	these concepts. They are capable of illustrating	these connections w	ith the help of examples.
	They know proof strategies and can reproduce the	m.		
Skills				
	Students can model problems in Mathematics IV w	rith the help of the concepts studied in this course	e. Moreover, they are	capable of solving then
	by applying established methods.			
	<ul> <li>Students are able to discover and verify further logi</li> </ul>	cal connections between the concepts studied in	the course.	
	<ul> <li>For a given problem, the students can develop and</li> </ul>	execute a suitable approach, and are able to cri	tically evaluate the re	esults.
Personal Competence				
Social Competence				
Coolai Competence	<ul> <li>Students are able to work together in teams. They a</li> </ul>	are capable to use mathematics as a common lar	iguage.	
	<ul> <li>In doing so, they can communicate new concepts</li> </ul>	according to the needs of their cooperating part	ners. Moreover, they	can design examples to
	check and deepen the understanding of their peers	S.		
Autonomy				
Adionomy	<ul> <li>Students are capable of checking their understand</li> </ul>	ding of complex concepts on their own. They ca	n specify open ques	tions precisely and know
	where to get help in solving them.			
	Students have developed sufficient persistence to	be able to work for longer periods in a goal-orien	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 Equation	ns 2)		
Assignment for the Following	General Engineering Science (German program): Special	sation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Special	sation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (German program): Speciali	sation Mechanical Engineering, Focus Theoretic	al Mechanical Engin	eering: Compulsory
	General Engineering Science (German program): Speciali	sation Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engineering, Foc	us Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineering
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Naval Architecture: Compulso	ry	
	Computer Science: Specialisation Computational Mathem			
	Electrical Engineering: Core qualification: Compulsory	F 7		
	General Engineering Science (English program): Specialis	sation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis		nics: Compulsory	
	General Engineering Science (English program): Specialis			ering: Compulsory
			-	Jonny. Jonnpuisory
	General Engineering Science (English program, 7 semest			nnulcon
	General Engineering Science (English program, 7 semest	, ,		
	General Engineering Science (English program, 7 sem	ester). Specialisation Mechanical Engineering,	rocus ineoretical	viecnanicai Engineering
	Compulsory			
	General Engineering Science (English program, 7 semest	•	ry	
	Computational Science and Engineering: Specialisation E			
	Computational Science and Engineering: Specialisation C	Computer Science: Elective Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mech	anical Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complement	entary Course Core Studies: Elective Compulsor	/	



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk		
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of 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	
	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	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	CP
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	<ul><li>Mathematics 1-3</li><li>Signals and Systems</li><li>Basic knowledge of probability theory</li></ul>			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	The students know and understand the fundamental building blocks blocks using knowledge of signal and system theory as well as evaluation criteria of information transmission and are able to design	he theory of stochastic processes.	The are aware of the	-
Skills	The students are able to design and evaluate a basic communic bandwidth and power. They are able to assess essential evaluatio 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 approp period by solving tutorial problems, software tools, clicker system.	iate literature sources. They can cor	ntrol their level of know	vledge 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 Ele	ctrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spec	alisation Electrical Engineering: Com	pulsory	
	Computer Science: Specialisation Computer and Software Enginee	ing: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Ele			
	General Engineering Science (English program, 7 semester): Speci		pulsory	
	Computational Science and Engineering: Specialisation Engineerin			
	Technomathematics: Specialisation III. Engineering Science: Electiv	e Compulsory		
	Technomathematics: Core qualification: Elective 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 Comm	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	



Module M0568: Theoretical	Electrical Engineering II: Time-Depende	ent 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, Theo	retical Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, Mathem	natics IV		
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence	J. 7,	0 0 1- 1-		
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subject relate sessions).	d tasks in small groups. They are able to pre	sent their results effectiv	ely (e.g. during exercis
Autonomy	Students are capable to gather necessary information reflect their knowledge by means of activities that account the exam. Based on respective feedback, students are acquired knowledge and ongoing research at the Ham	expected to adjust their individual learning pro	luring the lectures and ex ocess. They are able to dr	ercises that are related raw connections between
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	)		
Credit points	6			
Examination				
Examination duration and scale	90-150 minutes			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 ser		ompulsory	
	Electrical Engineering: Core qualification: Compulsory	, ,		
	General Engineering Science (English program): Spec			
	General Engineering Science (English program, 7 sen		ompulsory	
	Technomathematics: Specialisation III. Engineering Sci		•	
	Technomathematics: Core qualification: Elective Comp	nulsorv		



Course L0182: Theoretical Electrical	al Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	
Cycle	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 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 M0783: 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	nd the following learning results		
•	Anter taking part successionly, students have reache	to the following learning results		
Professional Competence	The students are able to surface the surrey of	otrology and the acquisition and accoming to	romonto There are de-	tail against of and a tail
Knowledge		etrology and the acquisition and processing of measure	•	
	theory and errors, and explain the processing of sto	ochastic signals. Students know methods to digitalize a	id describe measured	signais.
Skills	The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements.			
Personal Competence				
Social Competence	The students solve problems in small groups.			
Autonomy	The students can reflect their knowledge and discus	ss and evaluate their results.		
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 Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7	semester): Specialisation Electrical Engineering: Elect	ve Compulsory	
	Computer Science: Specialisation Computer and S	oftware Engineering: Elective Compulsory		
	Electrical Engineering: Core qualification: Compuls	sory		
	General Engineering Science (English program): S	pecialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 s	semester): Specialisation Electrical Engineering: Electrical	ve Compulsory	
	Computational Science and Engineering: Specialis	ation Engineering Sciences: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		
	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: 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 M0760: Electronic	Devices			
Courses				
Title		Тур	Hrs/wk	СР
Electronic Devices (L0720)		Lecture	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 I	Electrical Engineering or courses with e	equivalent contents	
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge				
	Students are able			
	to represent the basics of semiconductor physics,			
	to explain the operating principle of important semiconducte	or devices,		
	to outline device characteristics and equivalent circuits as v	vell as to explain their derivation and		
	to discuss the limitation of device models.			
Skills				
	Students are capable			
	Students are capable			
	to apply devices in basic circuits,			
	to realize the physical context and to solve complex probler	ns by oneself		
	to rounze the physical context and to conte complex product			
Personal Competence				
Social Competence	Students are able to prepare and perform their lab experiments in	eam work as well as to present and dis	cuss the results in front	of audience.
Autonomy	Students are capable to acquire knowledge based on literature in a	order to prepare their experiments.		
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 E	lectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spe		pulsory	
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation El	ectrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spec		oulsory	
	Computational Science and Engineering: Specialisation Computer	Science: Elective Compulsory		



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	ctor Circuit Design			
Courses				
Γitle		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L0763)		Lecture	3	4
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2
Module Responsible	Prof. Wolfgang Krautschneider			
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics			
	Dasies of physics			
<b>Educational Objectives</b>	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Children and the company that for a time of the continue of th	different MOC devices in all attention in aircrite		
	Students are able to explain the functionality of     Students know the fundamental digital logic circ		antagos	
		circuits and can explain their functionality and spec		
	Students have solid knowledge about memory to     Students are able to explain how analog circuits		silications.	
	Students know the appropriate fields for the use			
	Stademe taren are appropriate notes for the dec	or sipolar variousions.		
Skills				
	Students can calculate the specifications of different can be specifications.		of electronic circuits.	
		uits and can design different types of logic circuits.		
	<ul> <li>Students can use MOS devices, operational am</li> </ul>	plifiers and bipolar transistors for specific applicati	ons.	
Personal Competence				
Social Competence	Students are able work efficiently in heterogene	ous teams.		
		solve problems and answer professional question	S.	
Autonomy				
	Students are able to assess their level of knowledge.	edge.		
Workload in House	Independent Chidy Time 124 Chidy Time in Lecture 56			
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Spec	cialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Spec		ronics: Compulsory	
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			oulsory
	Computer Science: Specialisation Computer and Softw			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Speci	ialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Speci		onics: Compulsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Electrical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engineering, Fo	cus Mechatronics: Comp	ulsory
	Computational Science and Engineering: Specialisatio	n Computer Science: Elective Compulsory		
	Mechanical Engineering: Specialisation Mechatronics:	Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Comp	ulsory		
	Technomathematics: Specialisation III. Engineering Sci	ence: Elective Compulsory		



Typ Lecture  Hrs/wk 3  CP 4  Workload in Hours  Frof. Wolfgang Krautschneider  Lecturer  Prof. Wolfgang Krautschneider  Language  DE  Cycle  SoSe  Content  Basic circuits with MOS transistors for logic gates and amplifiers  Typical applications for analog and digital circuits  Bealization of logical functions  Memory circuits  Scaling-down of CMOS circuits and further performance improvements  Operational amplifiers and their applications  Design of exemplary circuits  Electrical behavoir of BiCMOS circuits  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, Halbleiter-Schaltungstechnik, Springer-Verlag, 14. Auflage, 2012, ISBN 3540428496  H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISE 9783642208867	Course L0763: Semiconductor Circ	uit Design
Workload in Hours Lecturer Prof. Wolfgang Krautschneider Language DE Cycle 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 performance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits Electrical behavoir of BiCMOS circuits  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, Halbleiter-Schaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISE 9783642208867	Тур	Lecture
Independent Study Time 78, Study Time in Lecture 42	Hrs/wk	3
Lecturer 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 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 Electrical behavoir of BiCMOS circuits  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 ISE 9783642208867	CP	4
Language 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 performance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits Electrical behavoir of BiCMOS circuits 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, Halbleiter-Schaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISB 9783642208867	Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
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 Coperational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS 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 ISB 9783642208867	Lecturer	Prof. Wolfgang Krautschneider
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 Electrical behavoir of BiCMOS circuits  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, Halbleiter-Schaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISB 9783642208867	Language	DE
<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 performance 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> <li>Literature</li> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISE 9783642208867</li> </ul>	Cycle	SoSe
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	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 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://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955

ourse L0864: Semiconductor Circuit Design	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Wolfgang Krautschneider
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0829: Foundation	
Courses	
Title	Typ Hrs/wk CP
Introduction to Management (L0880)	Lecture 3 3 Problem-based Learning 2 3
Project Entrepreneurship (L0882)	Prof. Christoph Ihl 2 3
Module Responsible  Admission Requirements	None None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	Sadio Midwicage of Mathematics and Sadiness
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation
	Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	a evaluin the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from
	<ul> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions fron field of Management</li> </ul>
	<ul> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> </ul>
	<ul> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and hu</li> </ul>
	ressource management, information management, innovation management and marketing
	explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business.
	some basic methods from mathematical Finance
	state basics from accounting and costing and selected controlling methods.
Skille	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry ou
OKIIIS	Entrepreneurship project in a team. In particular, they are able to
	and personal strip project in a team in particular, and a desire to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing     acleast and apply basic methods from methods from the first finance to prodefined problems.
	<ul> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
	work successfully in a team of students
	to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	to communicate appropriately and
	to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	work in a team and to organize the team themselves
	to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Examination	Written exam
Examination duration and scale	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
	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): 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: 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: Compute
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory  Constal Engineering Science (Cormon program, 7 compater), Specialization Machanical Engineering,
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Enginee



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
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. Wolfgang
	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 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
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.



## **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				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebrai	c structures including elementary combina	torial structures, mond	oids, groups, rings, fields,
	finite fields, and vector spaces. They also know specific structor	ures like sub sum-, and quotient structures	and homomorphisms.	
Skille	Students are able to formalize and analyze basic discrete algebraic structures.			
Skills	טוטטסחוס מוס מטוס וט וטוחומוניבס מווס מוומוויצבס טמסוט טוסטוסום מוציטוומוט סווטטונטוסס.			
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a gro	up and to present the results accordingly.		
Autonomy	Students are able to acquire new knowledge from specific sta	ndard books and to associate the aguired k	nowlodge to other elec	2000
Autonomy	Students are able to acquire new knowledge from specific sta	indard books and to associate the aquired ki	nowledge to other clas	3553.
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): Specialisati	on Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester)	Specialisation Computer Science: Compul	sory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	on Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Computer Science: Compuls	sory	
	Computational Science and Engineering: Core qualification:	Compulsory		
	Technomathematics: Specialisation I. Mathematics: Elective C	ompulsory		

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

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



Module M0553: Objectorier	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	Mandatary proroquicita for this locture is proficio	ncy in imperative programming (C, Pascal, Fortran or si	milar). Vau shauld ha	familiar with simple d
		, for, while, procedure calls or function calls, pointers, a		
		n editor, compiler, linker and debugger. In this lecture w	•	•
	objects and we will not repeat the basics mention		•	
	This was a discount of the Annual Co.	THE A COUNTY OF THE COUNTY OF	and a large Theorem	and the first facilities of the
		, LUM because those prerequisites are <b>not</b> part of the co		
	those curricula in general. The programs E1, Gra	and IIW include those prerequisites in the first semester in	i ille lecture Prozedura	ale Programmerung.
Educational Objectives	After teline and transport the standards have an all	had the fellowing leave in a verific		
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence  Knowledge	Students can explain the eccentials of coffware	decign and the decign of a close evaluation with re-	forance to evicting o	loop libraries and day
Knowieage	patterns.	e design and the design of a class architecture with re	nerence to existing c	iass libraries and des
	patients.			
	Students can describe fundamental data structure	es of discrete mathematics and assess the complexity of	important algorithms fo	or sorting and searchir
Skills	Students are able to			
	<ul> <li>Design software using given design patter</li> </ul>	rns and applying class hierarchies and polymorphism		
	<ul> <li>Carry out software development and tests</li> </ul>	using version management systems and Google Test		
	<ul> <li>Sort and search for data efficiently</li> </ul>			
	<ul> <li>Assess the complexity of algorithms.</li> </ul>			
Personal Competence				
Social Competence	Students can work in teams and communicate in	forums.		
Automorphis	Ot also to a second to the second sec	about 700 date of the control of the CVALD	1 O l . T l	and a second accordance of
Autonomy	of two to three weeks.	ich as LZW data compression using SVN Repository and	d Google Test Indeper	ndently and over a per
	of two to tiffee weeks.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6	0.00		
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)			
Curricula		7 semester): Specialisation Computer Science: Co	sorv	
Carricula	Computer Science: Core qualification: Compulso		,	
	Electrical Engineering: Core qualification: Compu	·		
	General Engineering Science (English program):			
	General Engineering Science (English program,	7 semester): Specialisation Computer Science: Compuls	ory	
	Computational Science and Engineering: Core qu	ualification: Compulsory		
	Logistics and Mobility: Specialisation Engineering	g Science: Elective Compulsory		
	Technomathematics: Core qualification: Compuls	sory		



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



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., arrays) 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				
	Students can show correspondences to Boolean algebra. Students can describe which application problems are hard to represent with proposition logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalisms that students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, a decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of fine automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic anondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is mexpressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily indialgorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms as logic, automata, or grammars.		epresentation formalism e syntax, semantics, and ne various kinds of finite from deterministic and nondeterminism is more n addition, students car ormalisms easily induce	
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	eory and Formal Languages
Тур	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)
	4. Deterministic finite automata, definition and construction
	5. Regular languages, closure properties, word problem, string matching
	6. Nondeterministic automata:
	Rabin-Scott transformation of nondeterministic into deterministic automata
	7. Epsilon automata, minimization of automata,
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
	8. Myhill-Nerode Theorem:
	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
	provision of a tool which, in some cases, can be used to show that a limite automator 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	A Local Calaterna Charles Only in Order of A fi
	Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.      Logik für Informatiker Martin Krauger, Staffen Krähling, Beargen Stadium, 2005.
	Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006     Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
	Grundkurs Theoretische Informatik, Gottined Vossen, Kurt-Offich Wilt, Vieweg-Verlag, 2010.     Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007.
	4. Thirdpied of model officiality, official ballet, obtact fellet field file WIT F1655, 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	



urses	
le	Tvp Hrs/wk CP
	Typ         Hrs/wk         CP           Lecture         3         4
nals and Systems (L0432) nals and Systems (L0433)	Recitation Section (large) 1 2
Module Responsible	Prof. Gerhard Bauch
Admission Requirements	None
Recommended Previous	Mathematics 1-3
Knowledge	indulchidulos 1-5
Momeage	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.
	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 as
	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 le
ŕ	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
	6
·	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: Comput
	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 Energy Systems. Computsory  General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Computs
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science Compulsory
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Engineering
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering



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

Course L0433: Signals and Systems	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				
tle		Тур	Hrs/wk	CP
roduction to Management (L0880) oject Entrepreneurship (L0882)		Lecture Problem-based Learning	3 2	3
Module Responsible	Prof. Christoph Ihl	1 Tobiem-based Learning		3
Admission Requirements	·			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of Marketing and Innovation, and also to Investment and Controlling		nagement, from Planr	ning and Organisation
	explain the differences between Economics and Manage	ment and the sub-disciplines in Managem	ent and to name impo	ortant definitions from t
	field of Management	rement and name the most important aspe	cts of entrepropurial r	projects
	explain the most important aspects of and goals in Manage     describe and explain basic business functions as produ			
	ressource management, information management, innov		onam management, c	organization and num
	explain the relevance of planning and decision making		Itiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected co	entrolling methods.		
Skills	Students are able to analyse business units with respect Entrepreneurship project in a team. In particular, they are able to		tives, strategies etc.	) and to carry out
	and the Management and a street we there are an area	atal.		
	<ul> <li>analyse Management goals and structure them appropria</li> <li>analyse organisational and staff structures of companies</li> </ul>	ately		
	apply methods for decision making under multiple object	ives, under uncertainty and under risk		
	analyse production and procurement systems and Busine			
	analyse and apply basic methods of marketing	·		
	select and apply basic methods from mathematical finance	ce to predefined problems		
	apply basic methods from accounting, costing and control	lling to predefined problems		
Personal Competence				
Social Competence				
	work successfully in a team of students      to apply their knowledge from the leature to an entrance.	ourship project and write a soberest report	on the project	
	to apply their knowledge from the lecture to an entrepren-     to communicate appropriately and	ediship project and write a conferent report	on the project	
	to cooperate respectfully with their fellow students.			
Autonomy				
	work in a team and to organize the team themselves     to write a report on their project.			
	to write a report on their project.			
	Independent Study Time 110, Study Time in Lecture 70			
Workload in Hours				
Workload in Hours Credit points	6			
Credit points Examination Examination duration and scale	Written exam 90 Minuten			
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 Minuten General Engineering Science (German program): Specialisation			
Credit points Examination Examination duration and scale	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory	ompulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Environmental Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Environmental Engineering: Co Civil- and Environmental Engeneering: Co		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Environmental Engineering: Co Civil- and Environmental Engeneering: Co Mechanical Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Co Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Con Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsory	mpulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Co Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsering: Compulser	mpulsory ulsory lsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Co Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsering: Compulser	ulsory ulsory lsory npulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German program, 7 semester): Specialise Engineering Science (German program)	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engeneering: Cotivil- and Enviromental Engeneering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Naval Archi	ulsory lsory npulsory pry	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Computer Science: Computer Sc	ulsory lsory npulsory ory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Computer Science: Compulsorialisation Computer Science: Compulsorialisation Bioprocess Engineering: Compulsorialisation Bio	ulsory lsory npulsory ory npulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Si	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Computer Science: Compulsorialisation Bioprocess Engineering: Compulsorialisation Bioprocess Engineering: Compulsorialisation Civil	ulsory lsory pulsory pry pry pry pulsory pry	y
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engeneering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Computer Science: Compulsorialisation Bioprocess Engineering: Compulsorialisation Civil Engineering: Compulsorialisation Civil Engineering: Compulsorialisation Energy and Enviromental Engineering: Compulsorialisation Engineer	ulsory lsory pulsory pry pry pulsory pry pulsory pulsory y gineering: Compulsor	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Sigeneral Engineering Science (G	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsory Decialisation Process Engineering: Compulsory Decialisation Biomedical Engineering: Compulsory Decialisation Naval Architecture: Compulsory Decialisation Computer Science: Compulsory Decialisation Bioprocess Engineering: Compulsory Decialisation Civil Engineering: Compulsory Decialisation Energy and Enviromental Engineering: Engineering, Focialisation Mechanical Engineering, Focialisation Mechanical Engineering, Focialisation Mechanical Engineering, Focialisation	ulsory lsory pulsory pry pry pulsory pulsory pulsory y gineering: Compulsor us Mechatronics: Cor	npulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Sigeneral Engineering Science (G	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsorialisation Process Engineering: Compulsorialisation Biomedical Engineering: Compulsorialisation Naval Architecture: Compulsorialisation Computer Science: Compulsorialisation Bioprocess Engineering: Compulsorialisation Givil Engineering: Compulsorialisation Givil Engineering: Compulsorialisation Energy and Enviromental Engineering, Fociocialisation Mechanical Eng	ulsory lsory pulsory pry pry pulsory pulsory y gineering: Compulsor us Mechatronics: Cor us Biomechanics: Co	npulsory mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Sigeneral Engineering Science (G	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsory Decialisation Process Engineering: Compulsory Decialisation Biomedical Engineering: Compulsory Decialisation Naval Architecture: Compulsory Decialisation Decialisation Computer Science: Compulsory Decialisation Bioprocess Engineering: Compulsory Decialisation Civil Engineering: Compulsory Decialisation Energy and Enviromental Engineering, Focialisation Mechanical Engineering,	ulsory lsory pulsory pry pry pulsory pulsory y gineering: Compulsor us Mechatronics: Cor us Biomechanics: Co	npulsory mpulsory ngineering: Compulso
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  90 Minuten  General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Sigeneral Engineering Science (G	Computer Science: Compulsory Process Engineering: Compulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cotivil- and Enviromental Engineering: Cotivil- and Enviromental Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Decialisation Electrical Engineering: Compulsory Decialisation Process Engineering: Compulsory Decialisation Biomedical Engineering: Compulsory Decialisation Naval Architecture: Compulsory Decialisation Decialisation Computer Science: Compulsory Decialisation Bioprocess Engineering: Compulsory Decialisation Civil Engineering: Compulsory Decialisation Energy and Enviromental Engineering, Focialisation Mechanical Engineering,	ulsory lsory pulsory pry pry pulsory pulsory y gineering: Compulsor us Mechatronics: Cor us Biomechanics: Co	npulsory mpulsory ngineering: Compulso



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

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

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
Compulsory

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

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

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



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

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	
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 The	ory and Optimization			
Courses				
Title		Тур	Hrs/wk	СР
Graph Theory and Optimization (L1046)		Lecture	2	3
Graph Theory and Optimization (L1047)		Recitation Section (small)	2	3
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	5:			
Knowledge	Discrete Algebraic Structures			
	Mathematics I			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Graph Theory a			
	Students can discuss logical connections between these	concepts. They are capable of illustrating	ig these connections wi	n the help of example
	They know proof strategies and can reproduce them.			
Skills				
	Students can model problems in Graph Theory and Option	mization with the help of the concepts stu	udied in this course. Mo	reover, they are capa
	of solving them by applying established methods.	and the second s	to the control of	
	Students are able to discover and verify further logical co     For a given problem, the students can develop and exect	·		
Personal Competence Social Competence	Students are able to work together in teams. They are cap			
	<ul> <li>In doing so, they can communicate new concepts accor check and deepen the understanding of their peers.</li> </ul>	ding to the needs of their cooperating pa	artners. Moreover, they	can design example
Autonomy	Students are capable of checking their understanding of the standard transfer and transfer	f complex concepts on their own. They	can specify open questi	ons precisely and k
	where to get help in solving them.  Students have developed sufficient persistence to be able	e to work for longer periods in a goal-orie	ented manner on hard n	roblems.
		2 to 110 to 10 to 190 portodo in a goar one	mainioi on nara p	
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): S	pecialisation Computer Science: Compu	Isory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	pecialisation Computer Science: Compul	sory	
	Computational Science and Engineering: Core qualification: Cor			
	Logistics and Mobility: Specialisation Engineering Science: Elec			
	Technomathematics: Specialisation I. Mathematics: Elective Cor	npulsory		



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	Graphs, search algorithms for graphs, trees planar graphs shortest paths minimum spanning trees maximum flow and minimum cut theorems of Menger, König-Egervary, Hall NP-complete problems backtracking and heuristics linear programming duality integer linear programming	
Literature	<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 O	Course L1047: Graph Theory and Optimization	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Anusch Taraz	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



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	or english) or 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 fo	llowing learning results		
Professional Competence	3,	3 3		
Knowledge	Students are able to			
Mowieage	Students are able to			
	<ul> <li>name numerical methods for interpolation, integra</li> </ul>	ation, least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and
	explain their core ideas,			
	<ul> <li>repeat convergence statements for the numerical management</li> </ul>	ethods,		
	<ul> <li>explain aspects for the practical execution of nume</li> </ul>	rical methods with respect to computational and	storage complexitx.	
Skills	Students are able to			
	• implement apply and compare numerical methods	using MATLAD		
	implement, apply and compare numerical methods     institute convergence behaviour of numerical methods		aarithm	
	<ul> <li>justify the convergence behaviour of numerical met</li> <li>select and execute a suitable solution approach for</li> </ul>		gonum,	
	Select and execute a suitable solution approach for	a given problem.		
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously composed team			age), explain theoretic
	foundations and support each other with practical a	spects regarding the implementation of algorithm	ns.	
Autonomy	Students are capable			
	to assess whether the supporting theoretical and process and process are also assess.		or in a team,	
	<ul> <li>to assess their individual progess and, if necessary</li> </ul>	, to ask questions and seek help.		
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): Speciali	eation Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Speciali		anics: Compulsory	
Carriodia	General Engineering Science (German program): Speciali	* *		nces: Compulsory
	General Engineering Science (German program): Speciali		III Engineering color	iocs. Compaisory
	General Engineering Science (German program, 7 semest		orv	
	General Engineering Science (German program, 7 sem		•	Engineering Science
	Compulsory	iosio.). Oposianoanon moonamoa. Engineering	,, roodo matorialo n	. Linginiouning colonia
	General Engineering Science (German program, 7 semest	er): Specialisation Biomedical Engineering: Con	npulsorv	
	General Engineering Science (German program, 7 semest			mpulsory
	Bioprocess Engineering: Specialisation A - General Biopro			
	Computer Science: Specialisation Computational Mathematical			
	Electrical Engineering: Core qualification: Elective Comput	• •		
	General Engineering Science (English program): Specialis	•		
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis		anics: Compulsory	
	General Engineering Science (English program): Specialis			ces: Compulsorv
	General Engineering Science (English program, 7 semesti	• •		
	General Engineering Science (English program, 7 semistration of the Control of th			Engineering Science
	Compulsory	, eperantum moonamaa Enginooning	, , , , , , , , , , , , , , , , , , , ,	.gg 20.01101
	General Engineering Science (English program, 7 semeste	er): Specialisation Biomedical Engineering: Com	ipulsory	
	General Engineering Science (English program, 7 semestr			mpulsory
		, . ,		r
	Computational Science and Engineering: Core qualification	n: Compulsory		



Course L0417: Numerical Mathematics I		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	DE	
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	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0793: Seminars 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, and	eventually Engineering Science.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a ru	dimentary field of Computer Science, Matl	hematics, or Engineering S	cience.
Skills	The students are able to elaborate self-reliantly a rudiment	ary subfield of Computer Science, Mathen	natics, or Engineering Scier	nce.
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): Specialis	sation Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semest	ter): Specialisation Computer Science: Cor	mpulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis	sation Computer Science: Compulsory		
	General Engineering Science (English program, 7 semeste	er): Specialisation Computer Science: Con	npulsory	
	Computational Science and Engineering: Core qualificatio	n: Compulsory		

Course L0797: Seminar Computational Mathematics/Computer Science		
Sourse Lorar. Seminar Computational Mathematics/Computer Science		
Тур	Seminar	
Hrs/wk	2	
СР	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	Seminar	
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 M0791: Computer A	Architecture			
Courses				
Title		Тур	Hrs/wk	СР
Computer Architecture (L0793)		Lecture	2	4
Computer Architecture (L0794)		Recitation Section (small)	2	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Module "Computer Engineering"			
Knowledge	The successful completion of the labs will be honored during the	evaluation of the module's examination ac	ccording to the followi	ng rules:
	Upon a passed module examination, the student is gra	anted a bonus on the examination's mai	rks due to the succes	ssful labs, such that the
	examination's marks are lifted 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, students have reached the followin	g learning results		
Professional Competence				
Knowledge	This module presents advanced concepts from the discipline of	computer architecture. In the beginning,	a broad overview ov	er 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 pa	articularly lies on the so-called pipelining	and the methods use	d for the acceleration of
	instruction execution used in this context. The students get to	know concepts for dynamic scheduling.	, branch prediction, s	uperscalar execution of
	machine instructions and for memory hierarchies.			
Skills	The students are able to describe the organization of processors.	They know the different architectural principle.	ciples and programmi	ng models. The students
	examine various structures of pipelined processor architecture	s and are able to explain their concepts	and to analyze ther	n w.r.t. criteria like, e.g.,
	performance or energy efficiency. They evaluate different stru	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 a	nd to present the results accordingly.		
	Ot dark and black and broad and a few or 17 th	and the constitute that the context of the	the construction of the co	
Autonomy	Students are able to acquire new knowledge from specific literatu	ire and to associate this knowledge with o	tner classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and 4 lab attestations			
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: Elective C	Compulsory	
	Computer Science: Specialisation Computer and Software Engin	eering: Elective Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp	·	ompulsory	
	Computational Science and Engineering: Specialisation Comput	er Science: Elective Compulsory		

Course L0793: Computer Architecto	ure
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, 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> </ul>
Literature	D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.     A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.



Course L0794: Computer Architecture	
Тур	Recitation Section (small)
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	siehe korrespondierende Lehrveranstaltung
	see interlocking course



Module M0834: Computern	etworks and Internet Security			
Courses				
Title		Тур	Hrs/wk	CP
Computer Networks and Internet Security	(L1098)	Lecture	3	5
Computer Networks and Internet Security		Recitation Section (small)	1	1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to explain important and common	Internet protocols in detail and classify them, in ord	der to be able to analyse	e and develop networked
	systems in further studies and job.			
Skilla	Students are able to analyse common Internet protoc	als and avaluate the use of them in different domai	20	
Skills	Students are able to analyse common internet protoc	ois and evaluate the use of them in different domai	115.	
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of high amount of professional knowledge and can independently learn and understand it.			
Autonomy	ottudents can select relevant parts out or night amount	of professional knowledge and carrindependently	ream and understand h	
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	General Engineering Science (German program): Sp	ecialisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Computer Science: Elective	re Compulsory	
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Elective Co	ompulsory		
	General Engineering Science (English program): Spe			
	General Engineering Science (English program, 7 se		e Compulsory	
	Computational Science and Engineering: Core quality	·		
	Technomathematics: Specialisation II. Informatics: Ele	• •		
	Technomathematics: Specialisation II. Informatics: Ele	ective 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	



Module M0731: Functional	Programming			
Wodule Wo731. Full clional	Frogramming			
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 follow	ring learning results		
Professional Competence				
Knowledge	Students apply the principles, constructs, and simple design	techniques of functional programming. The	ey demonstrate the	ir 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 p	rograms. 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 eva	luation strategies.		
Skills	Students break a natural-language description down in parts	amenable to a formal specification and deve	lon a functional proc	aram in a structured way
		·		•
	They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue			
	for the correctness of their program.	,		,,,
Personal Competence				
Social Competence	Students practice peer programming with varying peers. The	y explain problems and solutions to their po	eer. They defend the	eir programs orally. They
	communicate in English.			
Autonomy	In programming labs, students learn under supervision (a.k.a	. "Betreutes Programmieren") the mechanic	s of programming. In	exercises, they develop
,	solutions individually and independently, and receive feedbac	,	3 3	, , , , , , , , , , , , , , , , , , , ,
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 Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Computer Science: Elective C	ompulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	n Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Computer Science: Elective Co	ompulsory	
	Technomathematics: Specialisation II. Informatics: Elective Co	mpulsory		

Course L0624: Functional Programm	ning
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	<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		
СР	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 Programming		
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	See interlocking course	
Literature	See interlocking course	



Module M0727: Stochastics	S			
Courses				
Title		Тур	Hrs/wk	СР
Stochastics (L0777)		Lecture	2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	none			
Recommended Previous	Calculus			
Knowledge	Discrete algebraic structures (combinatorics)			
	Propositional logic			
	1 repositional regio			
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	Students can explain the main definitions of probability, and they ca	n give basic definitions of modeling	elements (rando	m variables, events,
	dependence, independence assumptions) used in discrete and continuo	dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can		
	describe characteristic notions such as expected values, variance, stan	ndard deviation, and moments. Stude	nts can define de	cision problems and
	explain algorithms for solving these problems (based on the chain rule	or Bayesian networks). Algorithms, o	r estimators as the	ey are caller, can be
	analyzed in terms of notions such as bias of an estimator, etc. Student ca	n describe the main ideas of stochast	ic processes and e	explain algorithms for
	solving decision and computation problem for stochastic processes. Stude			
Skills	Skills Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are good enough			d enough in various
	application contexts, i.e., students can derive estimators and judge whethe	r they are applicable or reliable.		
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			
Assignment for the Following	General Engineering Science (German program): Specialisation Compute	r Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisation	on Computer Science: Compulsory		
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Computer	Science: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation	on Computer Science: Compulsory		
	Computational Science and Engineering: Core qualification: Compulsory			
	Logistics and Mobility: Specialisation Engineering Science: Elective Comp	ulsory		



Course L0777: Stochastics		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Dr. 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	
	Stochastic processes	
	a Chathanaith, agus diaith	
	Stationarity, ergodicity     Correlations	
	Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues	
	5 J. Harris Saysonari Hottoring i Hottoring i Harris Hoto, quodoo	
	Detection & estimation	
	Detectors	
	Estimation rules and procedures	
	Hypothesis and distribution tests	
	Stochastic regression	
Literature		
	1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008	
	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	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	



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	- Obicat ariantad arranganian alamithana and d	de almostores		
Knowledge	Object-oriented programming, algorithms, and day	na structures		
	Procedural programming	stores avale as adition limitate according		
	Experience in using tools related to operating systems.      Experience in using C libraries.	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 systems, describe the process states and their			
	transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their			
	architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the			
	variants of realizing a file system. Students explain at lea	st three different scheduling algorithms.		
Chille	Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a			
Skills			ray. They are able to	Judge the elliciency of a
	scheduling algorithm for a given scheduling task in a giv	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 semi	ester): Specialisation Computer Science: Elective	Compulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specia	llisation Computer Science: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Specialisation Computer Science: Elective	Compulsory	
	Computational Science and Engineering: Specialisation	Computer Science: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Election	ve Compulsory		

Course L1153: Operating Systems		
Тур	ecture	
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



## **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 Desi	ign		
Mechanics			
Production Engineering			
After taking part successfully, students have reached the	ne following learning results		
After passing the module, students are able to:			
	e.g. considering load situation, materials and manu	tacturing requirements,	
<ul> <li>describe basics of 3D CAD,</li> </ul>			
<ul> <li>explain basics methods of engineering designing</li> </ul>	ng.		
After paging the module students are able to:			
Alter passing the module, students are able to.			
<ul> <li>independently create sketches, technical drawing</li> </ul>	ngs and documentations e.g. using 3D CAD,		
<ul> <li>design components based on design guideline</li> </ul>	es autonomously,		
<ul> <li>dimension (calculate) used components.</li> </ul>			
	design tasks systamtically and solution-oriented		
	acoign table by stamiliotiny and solution offenda,		
apply creativity techniques in teams.			
After passing the module, students are able to:			
dayalan and avaluate solutions in groups inclu-	ding making and documenting decicions		
	ung making and documenting decisions,		
<ul> <li>reflect the own results in the work groups of the</li> </ul>	course.		
Students are able			
		s),	
To solve engineering design tasks systematical	lly.		
Independent Study Time 40, Study Time in Lecture 140	0		
6			
Written exam			
180			
General Engineering Science (German program): Spec	cialisation Energy and Enviromental Engineering: (	Compulsory	<u></u>
General Engineering Science (German program): Spe	cialisation Mechanical Engineering: Compulsory		
General Engineering Science (German program): Sper	cialisation Biomedical Engineering: Compulsory		
		ompulsory	
		ngmeering: Compulsory	
• • • • • • • • • • • • • • • • • • • •	• •		
General Engineering Science (English program): Spec	cialisation Energy and Enviromental Engineering: C	Compulsory	
General Engineering Science (English program): Spec	cialisation Mechanical Engineering: Compulsory		
General Engineering Science (English program): Spec	cialisation Biomedical Engineering: Compulsory		
	3 0 1 7	and the same	
	nester): Specialisation Mechanical Engineering: Co	mpuisorv	
General Engineering Science (English program, 7 sem			
General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	nester): Specialisation Biomedical Engineering: Co	mpulsory	
General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	nester): Specialisation Biomedical Engineering: Conester): Specialisation Energy and Enviromental En	mpulsory	
General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	nester): Specialisation Biomedical Engineering: Conester): Specialisation Energy and Enviromental En	mpulsory	
	Fundamentals of Mechanical Engineering Desi Mechanics Fundamentals of Materials Science Production Engineering  After taking part successfully, students have reached the successfully and students are able to: explain design guidelines for machinery parts of describe basics of 3D CAD, explain basics methods of engineering designing the module, students are able to: independently create sketches, technical drawing design components based on design guidelines of dimension (calculate) used components, use methods to design and solve engineering of apply creativity techniques in teams.  After passing the module, students are able to: develop and evaluate solutions in groups inclued moderate the use of scientific methods, present and discuss solutions and technical drawing reflect the own results in the work groups of the students are able to estimate their level of knowledge using activations are able to estimate their level of knowledge using activations are able to estimate their level of knowledge using activations are able for solve engineering design tasks systematical and pendent Study Time 40, Study Time in Lecture 144 and the study Time 40, Study Time in Lecture 144 and the study Time 40, Study Time in Lecture 144 and the study Time Science (German program): Speceneral Engineering Science (German program): Speceneral Engineering Science (German program, 7 sereneral Engineering Science (English program): Speceneral Engineering Science (English program): Speceneral Engineering Scie	Prundamentals of Mechanical Engineering Design  Mechanics  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 manu 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 clicker To solve engineering design tasks systematically.  Independent Study Time 40, Study Time in Lecture 140  General Engineering Science (German program): Specialisation Energy and Environmental 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 Energy and Environmental Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory G	Practical Course 3 Practical Course 3 Practical Course 3 Problem-based Learning 2  Prof. Dieter Krause  Fundamentals of Mechanical Engineering Design  • Fundamentals of Mechanics • Fundamentals of Materials Science • Production Engineering  • 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 manufacturing requirements, • 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  3  Written exam  1800  Sciencel Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory  Sciencel Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  Sciencel Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory  Sciencel Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory  Sciencel Engineering Science (English program)



Naval Architecture: Core qualification: Compulsory

Course L0268: Embodiment Design	and 3D-CAD
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Basics of 3D CAD technology  Practical course to apply a 3D CAD system  Introduction to the system  Sketching and creation of components  Creation of assemblies  Deriving technical drawings
Literature	<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		
	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 R	Course L0592: Mechanical Design Project II	
Тур	Practical Course	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	SoSe	
Content	Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing)	
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH., Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.	

Course L0267: Team Project Design 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>	



Courses				
litle little		Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L10	35)	Lecture	2	2
Fundamentals of Materials Science II (Adv	ranced 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 i	netals, ceramics and polymers	and can describe this know	vledge comprehensiv
	Fundamental knowledge here means specifically the issues of			
	mechanical properties. The students know about the key aspe		•	
	characterizing specific properties. They are able to trace materia	is phenomena back to the underlyi	ing physical and chemical lav	ws of nature.
Skills	The students are able to trace materials phenomena back to the	e underlying physical and chemica	al laws of nature. Materials p	henomena here refer
	mechanical properties such as strength, ductility, and stiffness,	chemical properties such as corros	sion resistance, and to phase	transformations such
	solidification, precipitation, or melting. The students can explain	the relation between processing	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 Engine	ering: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compul	sory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compuls	sory	
	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		ental Engineering: Compulsor	ry
	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		sory	
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Sp		na: Compulsory	
	General Engineering Science (English program, 7 semester): Sp. General Engineering Science (English program, 7 semester): Sp.			
	General Engineering Science (English program, 7 semester): Sp.			
	General Engineering Science (English program, 7 semester): Sp.			v
	Logistics and Mobility: Specialisation Engineering Science: Elec		gcog. copulsol	,
	Mechanical Engineering: Core qualification: Compulsory	20pa.oo.,		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			

Course L1085: Fundamentals of Ma	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
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
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 fields in particular ferromagnetic circuits with air gap. For this they apply the usual methods of the design auf electric machines.			
	They can calulate the operational performance of electric machines from they apply the usual equivalent circuits and graphical methods.	n their given characteristic data and	selected quantities a	nd characteristic curves.
Personal Competence Social Competence Autonomy	none Students are able independently to calculate electric and magnatic f performance of electric machines from the charactersitic data and theyco			
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 Ma	nagement			
Courses					
Title		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 have	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 prog	ram): Specialisation Mechanical Engineering: Elective Co	mpulsory		
Curricula	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechanical Engineering	: Elective Compulsory		
	General Engineering Science (English progr	ram): Specialisation Mechanical Engineering: Elective Co	mpulsory		
	General Engineering Science (English progr	ram, 7 semester): Specialisation Mechanical Engineering:	Elective Compulsory		
	Logistics and Mobility: Specialisation Engine	eering Science: Elective Compulsory			
	Mechanical Engineering: Core qualification:	Elective Compulsory			

Course L0925: Production Process	Organization
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	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>



ourses				
tle		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 sy	rstems. Good knowledge in maths as covere	d by the moduls Mat	hematik 1-3 is expe
	Further experience with spectral transformations (Fourier seri			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and lin			
	to apply the fundamental transformations of continuous-time a			
	and systems mathematically in both time and image domai		in time domain and i	mage domain which
	caused by the transition of a continuous-time signal to a discr			
Skills	The students are able to describe and analyse deterministic	·	-	
	can analyse and design basic systems regarding important p		oonse, stability, linear	ity etc They can as
	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 a		rol their level of know	rledge during the lea
	period by solving tutorial problems, software tools, clicker sys	tem.		
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): Specialisat			
Curricula	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisat			
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	General Engineering Science (German program): Specialisat		mpulsory	
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisat			
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	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering, Foo	us Mechatronics: Cor	npulsorv
	General Engineering Science (German program, 7 semestry)			
	Compulsory	, inginoding		
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisati	on Civil- and Enviromental Engeneering: Cor	npulsory	
	General Engineering Science (English program): Specialisati		-	
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program): Specialisati	on Computer Science: Compulsory		
	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 Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Computer Science: Compulso	ory	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engineering	, Focus Materials in	Engineering Scier
	Compulsory	Pagaigliagtian Machanian Francisco	ua Maahataa i C	anulaan.
	General Engineering Science (English program, 7 semester): General Engineering Science (English program, 7 semest			
	Lisenaral Engineering Science (English program 7 semest	eri: Specialisation Mechanical Engineering.	Focus Inegretical	nechanical Enginee
				neonamear Enginee
	Compulsory Computational Science and Engineering: Core qualification:			neonamear Enginee



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 DE/EN
Language	
Content	Basic classification and description of continuous-time and discrete-time signals and systems
	Concvolution
	Power and energy of signals
	Correlation functions of deterministic signals
	Linear time-invariant (LTI) systems
	Signal transformations:
	Fourier-Series
	Fourier Transform
	Laplace Transform
	Discrete-time Fourier Transform
	Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
	• Z-Transform
	Analysis and design of LTI systems in time and frequency domain
	Basic filter types
	Sampling, sampling 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



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Course L0454: Fluid Mechanics		
Тур	ecture	
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 M0934: Advanced I	Materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterization (L10	87)	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	ng results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced mater	ials along with their applications	in technology, in par	ticular metallic, ceramic,
	polymeric, semiconductor, modern composite materials (biomaterials) are	nd nanomaterials.		
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence Social Competence	The students are able to present solutions to specialists and to develop in	deas 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 Mechan	nical Engineering: Elective Compu	lsory	
Curricula	General Engineering Science (German program, 7 semester): Specialisa	ation Mechanical Engineering: Ele	ctive Compulsory	
	General Engineering Science (English program): Specialisation Mechan	ical Engineering: Elective Compul	sory	
	General Engineering Science (English program, 7 semester): Specialisa		•	
	Mechanical Engineering: Core qualification: Elective Compulsory	- 0		

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



	IV (Kinetics II, Oscillations, Analytical Mechan			
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
lechanics IV (Kinetics II, Oscillations, An	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 follow	ring learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in mechanical of the control of the co	ontexts;		
	<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 / mechanical analysis and model formation, and apply it to the context of their own problems;			
	apply basic methods to engineering problems;			
	<ul> <li>estimate the reach and boundaries of the methods and</li> </ul>	extend them to be applicable to wider probl	em sets.	
Personal Competence				
Social Competence	The students can work in groups and support each other to over	ercome difficulties.		
Autonomy	Students are capable of determining their own strengths and w	reaknesses and to organize their time and le	earning based on thos	se.
rictionary	ended the day of the control of the	oa.a.ooooo a.a o o.gazo a.o. ao a.a .	arming bassa or area	
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	on Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	on Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	on Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Naval Architecture: Compulse	ory	
	General Engineering Science (English program): Specialisation	n Mechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	n Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	n Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Naval Architecture: Compulso	ory	
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: E	lective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Complementa	ry Course Core Studies: Elective Compulsor	ν	

Course L1137: Mechanics IV (Kineti	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 (Kineti	ourse 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	



Courses				
Title	10	Тур	Hrs/wk	CP
Practical Course: Measurement and Contr		Laboratory Course Lecture	2	2
Measurement Technology for Mechanical Measurement Technology for Mechanical		Recitation Section (large)	1	1
	Dr. Sven Krause	rectation dection (large)	ı	'
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineeri	ing		
Knowledge	basic knowledge of physics, chemistry and electrical engineer	ing .		
Educational Objectives	After taking part successfully, students have reached the follow	ring looming requite		
•	After taking part successionly, students have reached the follow	ing rearring results		
Professional Competence	Students are able to name the most important fundmentals of	the Massurament Technology (Quantities	and Unita Uncertaint	Colibration Statio
Knowledge	Students are able to name the most important fundmentals of	the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for di	fferent kinds of quantities to be maesured	(Electrical Quantities,	Temperature, mechan
	quantities, Flow, Time, Frequency).			
	They can describe important matheds of shamised Analysis (Co	as Sanaara Sanaatraasany Cas Chramatas	ranhu)	
	They can describe important methods of chemical Analysis (Ga	as Sensors, Speciroscopy, das Chromatog	гарпу)	
Chille	Children and a color to the blance and the date of the color			
Skills	Students can select suitable measuring methods to given prob	iems and can use retering measurement o	evices in practice.	
	The students are able to orally explain issues in the subject at	rea of measurement technology and soluti	ion approaches as wel	I as place the issues
	the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and document the	em in a common report.		
Autonomy	Students are able to familiarize themselves with new measurer	ment 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): Specialisation	on Energy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation	on Mechanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	on Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	on Process Engineering: Compulsory		
	General Engineering Science (German program, 7 semester):	Specialisation Energy and Enviromental E	ngineering: Compulsor	y
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester):			
	$\label{thm:continuous} General\ Engineering\ Science\ (German\ program,\ 7\ semester):$	Specialisation Process Engineering: Comp	oulsory	
	Energy and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisation		Compulsory	
İ	General Engineering Science (English program): Specialisatio	0 0 1 7		
	Ganaral Engineering Science (English program): Specialisation	n Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisatio			
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): \$	Specialisation Energy and Enviromental Er		у
	General Engineering Science (English program): Specialisatio General Engineering Science (English program, 7 semester): \$ General Engineering Science (English program, 7 semester): \$	Specialisation Energy and Enviromental Er Specialisation Mechanical Engineering: Co	ompulsory	y
	General Engineering Science (English program): Specialisatio General Engineering Science (English program, 7 semester): \$ General Engineering Science (English program, 7 semester): \$ General Engineering Science (English program, 7 semester): \$	Specialisation Energy and Enviromental Err Specialisation Mechanical Engineering: Co Specialisation Biomedical Engineering: Co	ompulsory mpulsory	у
	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 General Engineering Science (English program, 7 semester): S	Specialisation Energy and Enviromental Err Specialisation Mechanical Engineering: Co Specialisation Biomedical Engineering: Co	ompulsory mpulsory	у
	General Engineering Science (English program): Specialisatio General Engineering Science (English program, 7 semester): \$ General Engineering Science (English program, 7 semester): \$ General Engineering Science (English program, 7 semester): \$	Specialisation Energy and Enviromental Err Specialisation Mechanical Engineering: Co Specialisation Biomedical Engineering: Co	ompulsory mpulsory	у



T	Laboratory Course
	Laboratory Course
Hrs/wk	2
CP	
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 investigated. I 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 Michels 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., Wissenschaftli Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münch 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	2			
CP.				
Workload in Hours Lecturer	Independent Study Time 62, Study Time in Lecture 28			
Language	Dr. Sven Krause DE			
Cycle				
Content	1 Fundamentals			
	1.1 Quantities and Units			
	1.2 Uncertainty			
	1.3 Calibration			
	1.4 Static and Dynamic Properties of Sensors and Systems			
	2 Measurement of Electrical Quantities			
	2.1 Current and Voltage			
2.2 Impedance				
	2.3 Amplification			
	2.4 Oscilloscope			
	2.5 Analog-to-Digital Conversion			
	2.6 Data Transmission			
	3 Measurement of Nonelectric Quantities			
	3.1 Temperature			
	3.2 Length, Displacement, Angle			
	3.3 Strain, Force, Pressure			
	3.4 Flow			
	3.5 Time, Frequency			
	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 M0829: Foundation	
Courses	
Title	Typ Hrs/wk CP
Introduction to Management (L0880)	Lecture 3 3  Problem-based Learning 2 3
Project Entrepreneurship (L0882)  Module Responsible	
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	and the model of manifestation and additional
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and to name important definitions from the difference between Economics and Management and the sub-disciplines in Management and the sub-discip
	field of Management
	<ul> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and humanical contents.</li> </ul>
	ressource management, information management, innovation management and marketing
	explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain
	some basic methods from mathematical Finance
	state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies      analyse organisational and staff structures of companies
	<ul> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> </ul>
	analyse production and procedenism systems and business mormation systems     analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
coolai compotento	
	work successfully in a team of students
	to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	to communicate appropriately and  A separate respect to the second of the second
	to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	work in a team and to organize the team themselves
	to write a report on their project.
	to the analysis project
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	
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 Process Engineering: Compulsory  General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmental 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): 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 Civil 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 Aircraft Systems Engineering: Compulsor
	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

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

Compulsory

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				
CP	3				
Workload in Hours					
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, 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 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		
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.		



## **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 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			
	- Commence of the Commence of			



Course L0384: Introduction to Anato	эту		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Tobias Lange		
Language	DE .		
Cycle	SoSe General Anatomy		
	1st week: The Eucaryote Cell 2nd week: The Tissues 3rd week: Cell Cycle, Basics in Development 4th week: Musculoskeletal System 5th week: Cardiovascular System 6th week: Respiratory System 7th week: Genito-urinary System 8th week: Immune system 9th week: Digestive System I 10th week: Digestive System II		
	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		



ırses				
		<b></b>	Hereford OR	
duction to Radiology and Radiation TI	nerany (I 0383)	Typ Lecture	Hrs/wk CP	
Module Responsible	Prof. Ulrich Carl	Lecture	2 3	
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge				
	Therapy			
	The students can distinguish different types of current	ly used equipment with respect to its use in radia	ation therapy.	
	The students can explain complex treatment plans us	ed in radiation therapy in interdisciplinary conte	xts (e.g. surgery, internal medicine).	
	The students can describe the patients' passage from	their initial admittance through to follow-up care	o.	
	Diagnostics			
	The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as section 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 d	depending on the patient's clinical history and ne	eeds.	
	The student can explain the influence of technical error	ors on the imaging techniques.		
	The student can draw the right conclusions based on	the images' diagnostic findings or the error prote	ocol	
	The stadent dan draw the right denotes one based on	are images diagnosis intellige of the error prote	3301.	
Skills	Theren			
	Therapy			
	The students can distinguish curative and palliative si	tuations and motivate why they came to that con	clusion.	
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.			
	The students can use the therapeutic principle (effects vs adverse effects)			
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).			
	The student can assess what an individual psychoso social services, psycho-oncology).	ocial service should look like (e.g. follow-up trea	atment, sports, social help groups, self-help grou	
	Diagnostics			
	The students can suggest solutions for repairs of imag	ging instrumentation after having done error ana	lyses.	
	The students can classify results of imaging techniqu pathophysiology.	es according to different groups of diseases ba	sed on their knowledge of anatomy, pathology	
Personal Competence				
Social Competence				
	The students can assess the special social situation o	of tumor patients and interact with them in a profe	essional way.	
	The students are aware of the special, often fear-dom	inated behavior of sick people caused by diagn	ostic and therapeutic measures and can meet the	
	appropriately.			
Autonomy				
ridonomy	The students can apply their new knowledge and skill	Is to a concrete therapy case.		
	The students can introduce younger students to the cl			
	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	3		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 minutes	anialization Manhardad Foots 1 5 5	manhanian Campulana	
Assignment for the Following Curricula	General Engineering Science (German program): Spe General Engineering Science (German program): Spe		• •	
Curricula	General Engineering Science (German program): Spe General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se		• •	
	Electrical Engineering: Specialisation Medical Techno		•	
	General Engineering Science (English program): Spe			
	General Engineering Science (English program): Spe General Engineering Science (English program): Spe General Engineering Science (English program, 7 sei	cialisation Biomedical Engineering: Compulsor	у	



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
СР	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 M0646: BIO I: Impla	nts and Testing			
Courses				
litle		Тур	Hrs/wk	СР
Experimental Methods in Biomechanics (L	0377)	Lecture	2	3
mplants and Fracture Healing (L0376)	,	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate und Frakturhe	ilung" before attending "Experimentell	e Methoden".	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the folio	wing learning results		
Professional Competence				
Knowledge	The students can describe the different ways how bones hea	, and the requirements for their exister	nce.	
	The students can name different treatments for the spine and	hollow bones under given fracture mo	rphologies.	
	The students can describe different measurement techniques	for forces and movements, and choos	se the adequate technique for	a given task.
Skills	The students can determine the forces acting within the huma	an body under quasi-static situations u	nder specific assumptions.	
	The students can describe the basic handling of several expe	erimental techniques used in biomecha	anics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic experimental tasks.			
Autonomy	The students can, in groups, solve basic experimental tasks.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, many questions			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus B	iomechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisa		• •	
	General Engineering Science (German program, 7 semester		•	mpulsory
	General Engineering Science (German program, 7 semester			
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Bi	omechanics: Compulsory	
	General Engineering Science (English program, 7 semester)			npulsory
	General Engineering Science (English program, 7 semester)			•
	Mechanical Engineering: Specialisation Biomechanics: Com			
	Biomedical Engineering: Specialisation Artificial Organs and	•	pulsory	
	Biomedical Engineering: Specialisation Implants and Endopr			
	Biomedical Engineering: Specialisation Medical Technology		ory	
	Biomedical Engineering: Specialisation Management and Bu			
	Technomathematics: Specialisation III. Engineering Science:			

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



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



Courses				
Title	Т	Гур	Hrs/wk	СР
Numerical Mathematics I (L0417)		ecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematik I + II for Engineering Students (german or english) or Anal     basic MATLAB knowledge	lysis & Linear Algebra I + II fo	or Technomathematici	ans
	·			
Educational Objectives	After taking part successfully, students have reached the following learning re	sults		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration, least squares	s problems, eigenvalue prob	olems, nonlinear root	finding problems and
	explain their core ideas,			
	<ul> <li>repeat convergence statements for the numerical methods,</li> </ul>			
	explain aspects for the practical execution of numerical methods with r	respect to computational and	storage complexitx.	
Skills	Students are able to			
	implement, apply and compare numerical methods using MATLAB,			
	justify the convergence behaviour of numerical methods with respect to	o the problem and solution a	laorithm	
	select and execute a suitable solution approach for a given problem.	o the problem and solution a	ngonum,	
	estation approach to a given problem			
Personal Competence				
Social Competence	Students are able to			
	a work together in heterogeneously composed tooms (i.e. tooms from	different etudy programe er	d bookground knowle	adaa) ayalain thaara
	work together in heterogeneously composed teams (i.e., teams from foundations and support each other with practical accounts regarding the control of t			euge), explain illeorei
	foundations and support each other with practical aspects regarding the	ie impiementation of algorith	11115.	
Autonomy	Students are capable			
		and batter as board in divide all.		
	to assess whether the supporting theoretical and practical excercises and the assess their individual progress and if progress are the sale guestions as		or in a leam,	
	<ul> <li>to assess their individual progess and, if necessary, to ask questions a</li> </ul>	ти зеек петр.		
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 Computer Sc	cience: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Mechanical		nanics: Compulsory	
	General Engineering Science (German program): Specialisation Mechanical	-		nces: Compulsory
	General Engineering Science (German program): Specialisation Biomedical B		3 3	, , , , , , , , , , , , , , , , , , , ,
	General Engineering Science (German program, 7 semester): Specialisation		sory	
	General Engineering Science (German program, 7 semester): Specialisat		-	n Engineering Science
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation	Biomedical Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester): Specialisation			ompulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering:	Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Com	pulsory		
	Electrical Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation Computer Science	cience: Compulsory		
	General Engineering Science (English program): Specialisation Biomedical E	Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical E	Engineering, Focus Biomech	anics: Compulsory	
	General Engineering Science (English program): Specialisation Mechanical E	Engineering, Focus Materials	in Engineering Scier	ices: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation (	Computer Science: Compuls	ory	
	General Engineering Science (English program, 7 semester): Specialisat			n Engineering Science
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation E	3iomedical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester): Specialisation M			mpulsory
	Computational Science and Engineering: Core qualification: Compulsory	- <del>-</del>		-
	1			



Course L0417: Numerical Mathema	tics I	
Тур	Lecture	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	DE	
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	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	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0684: Heat Trans	ier			
module moods. Heat Harist				
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)		Recitation Section (large)	2	1
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	ich.		
Autonomy	The students are able to develop a complex problem self-consistent and	d analyse the results in a critical w	ay. A qualified exchan	ge with other students is
	given.			
Wantaland in Harris	Indiana and art Chiefe Time 110. Chiefe Time in Landing 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			
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		and Marchandard English	
	General Engineering Science (German program): Specialisation Mecha			
	General Engineering Science (German program, 7 semester): Specialisa		• • •	
	General Engineering Science (German program, 7 semester): Specia	ansanon Mechanical Engineering	i, rocus medieticai i	lechanical Engineering.
	Compulsory	ation Biomadical Engineering: Co.	maulaari	
	General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Specialisation Biomed		inpuisory	
	General Engineering Science (English program): Specialisation Biomed General Engineering Science (English program): Specialisation Mechan		anice: 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): Specialisation Mediat			
	General Engineering Science (English program, 7 semester): Specialisa			
	Compulsory		, . ccao micorcadar iv	.coaioai Enginoeiiiig.
	General Engineering Science (English program, 7 semester): Specialisa	tion Biomedical Engineering: Cor	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulsory	J 11 J. 40.		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering	ering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, 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	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1270: MED II: Intro	oduction to Biochemistry and Molecula	ar Riology		
Wodule W1279. WED II: IN(r)	duction to blochemistry and molecula	ar blology		
Courses				
Title		Тур	Hrs/wk	CP
Introduction to Biochemistry and Molecular	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
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			
	<ul> <li>describe basic biomolecules;</li> </ul>			
	<ul> <li>explain how genetic information is coded in t</li> </ul>	he DNA:		
	explain the connection between DNA and pro			
	·			
Skills				
	The students can			
	recognize the importance of molecular paran	neters for the course of a disease;		
	describe different molecular-diagnostic treatr	nents;		
	d	- di		
	describe the importance of those treatments for some	e diseases;		
Personal Competence				
Social Competence				
	The students can conduct discussions in research a	nd medicine on a technical level.		
Autonomy	The students can develop understanding of topics from	om the course using technical literature, by themse	alvas	
Autonomy	The students can develop understanding of topics in	on the course, using technical interature, by themse	eives	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 2	8		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Mechanical Engineering, Focus Biom	echanics: Compulsory	
Curricula	General Engineering Science (German program): Sp	pecialisation Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 s	emester): Specialisation Biomedical Engineering:	Compulsory	
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical Engineering,	Focus Biomechanics: Com	npulsory
	Electrical Engineering: Specialisation Medical Technology			
	General Engineering Science (English program): Sp		echanics: Compulsory	
	General Engineering Science (English program): Sp			
	General Engineering Science (English program, 7 sc			pulsory
	General Engineering Science (English program, 7 s	, ,	Compulsory	
	Mechanical Engineering: Specialisation Biomechan			
	Biomedical Engineering: Specialisation Management Biomedical Engineering: Specialisation Artificial Organical Engineering: Specialisation Artificial Organical Engineering: Specialisation Management			
	Biomedical Engineering: Specialisation Artificial Org		•	
	Biomedical Engineering: Specialisation Implants and	**		
	Technomathematics: Core qualification: Elective Cor			
	Technomathematics: Specialisation III. Engineering			

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



Module M1280: MED II: Intro	oduction to Physiology
The state of the s	
Courses	
Title	Typ Hrs/wk CP
ntroduction to Physiology (L0385)	Lecture 2 3
Module Responsible	Dr. Roger Zimmermann
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
	The students can
	describe the basics of the energy metabolism;
	<ul> <li>describe physiological connections in select fields of muscle, heart/circulation, neuro- and sensory physiology.</li> </ul>
Skills	
	The students can
	describe the effects of basis hadily functions (consequences) and proceeding of information, development of forces and vital functions.
	<ul> <li>describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vital functions)</li> <li>relate them to similar technical systems.</li> </ul>
	totale from 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 develop understanding of topics from the course, 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
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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



## **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	n II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design	n 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 Des	ian		
Knowledge	Mechanics	911		
	Fundamentals of Materials Science			
	Production Engineering			
	Troduction Engineering			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
_				
		ns of machine elements and of basic elements of flui		
	explain requirements, selection criteria, applica	ation scenarios and practical examples of complex m	achine elements,	
	indicate the background of dimensioning calcu	lations.		
Skills	After passing the module, students are able to:			
o.i.iio	The passing the medic, stadents are asie to:			
	<ul> <li>accomplish dimensioning calculations of cover</li> </ul>	ed machine elements,		
	<ul> <li>transfer knowledge learned in the module to ne</li> </ul>	ew requirements and tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings an</li> </ul>	d schematic sketches,		
	<ul> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	Students are able to discuss technical informat	ion in the lecture supported by activating methods.		
		,, ,		
Autonomy	Students are able to independently deepen the	air acquired knowledge in evercises		
	<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 of</li> </ul>			
	Students are able to acquire additional knowledge and to recapitulate poonly understood content e.g. by using the video recordings of lectures.			
	lectures.			
Markland in Harris	Independent Study Time 68, Study Time in Lecture 11:	2		
Workload in Hours				
Workload in Hours  Credit points	6			
	6 Written exam			
Credit points				
Credit points Examination Examination duration and scale	Written exam 120	cialisation Mechanical Engineering Focus Energy S	vstems: Compulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 120 General Engineering Science (German program): Spe			Compulsory
Credit points Examination Examination duration and scale	Written exam 120 General Engineering Science (German program): Spe General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 120 General Engineering Science (German program): Spe General Engineering Science (German program): Spe General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials	ystems Engineering: ( in Engineering Scien	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro	ystems Engineering: ( in Engineering Scien nics: Compulsory	ices: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I	ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Pro	duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic	ystems Engineering: ( in Engineering Scien inics: Compulsory Development and Pro al Mechanical Engine	duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, Foc	ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Pro- ial Mechanical Engine us Aircraft Systems E	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set General Engineering Science (German program, 7	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, Foc	ystems Engineering: ( in Engineering Scien nics: Compulsory Development and Pro- ial Mechanical Engine us Aircraft Systems E	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set General Engineering Science (German program, 7 Compulsory	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product E cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, Focus Eng	ystems Engineering: in Engineering Scient nics: Compulsory Development and Pro- ial Mechanical Engine us Aircraft Systems Ei J, Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls Engineering Scien
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatrocialisation Mechanical Engineering, Focus Product Ecialisation Mechanical Engineering, Focus Theoretic Mester): Specialisation Mechanical Engineering, Focus Engin	ystems Engineering: in Engineering Scient in Engineering Scient inics: Compulsory Development and Proval Mechanical Engine us Aircraft Systems Ely, Focus Materials in us Mechatronics: Cor	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls Engineering Scien
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 sei General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sei	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatrocialisation Mechanical Engineering, Focus Product Ecialisation Mechanical Engineering, Focus Theoretic Mester): Specialisation Mechanical Engineering, Focus Engin	ystems Engineering: in Engineering Scient in Engineering Scient inics: Compulsory Development and Proval Mechanical Engine us Aircraft Systems Ely, Focus Materials in us Mechatronics: Cor	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls Engineering Scien
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 set Compulsory	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, Focus Emester): Specialisation Mechanical Engineering, Focus Engin	ystems Engineering: (in Engineering Scien nics: Compulsory Development and Proval Mechanical Engineus Aircraft Systems Elg, Focus Materials in us Mechatronics: CorFocus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls Engineering Scien mpulsory opment and Produc
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Spe General Engineering Science (German program, 7 set General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 set General Engineering Science (German program, 7 set General Engineering Science (German program, 7 set Compulsory General Engineering Science (German program, 7 set Compulsory General Engineering Science (German program, 7	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, Focus Emester): Specialisation Mechanical Engineering, Focus Engin	ystems Engineering: (in Engineering Scien nics: Compulsory Development and Proval Mechanical Engineus Aircraft Systems Elg, Focus Materials in us Mechatronics: CorFocus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls Engineering Scien mpulsory opment and Produc
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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

	internalical Engineering, Core qualification, Computatory		
	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		
	o Seals		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank drives		
	Sliding bearings		
	Elements of fluidics		
	orgina		
	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			
Enterature	<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.		
	<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.		

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

Sowie weitere Bücher zu speziellen Themen

• Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.



Course L0262: Advanced Mechanic	al Engineering Design I		
Тур	Lecture		
Hrs/wk	2		
CP			
Workload in Hours	dent 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 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.  Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.		
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Finführung in die DIN-Normen: Klein M. Teubner-Verlag</li> </ul>		
	<ul> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> </ul>		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	<ul> <li>Maschinenelemente - 2, Schlecht, B., Pearson Verlag, axuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> </ul>		
	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			
·	<u> </u>			
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	exnansions		
	- Tandamentals of Emorentalymogral salicates and series	oxpansions .		
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	ial equations.		
Skills	The students are able develop appropriate numerical integrat	on 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	hem.		
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 S	ystems: Compulsorv	
Curricula	General Engineering Science (German program): Specialisation		,	
22.770414	General Engineering Science (German program, 7 semester): Sp		ory	
	General Engineering Science (German program, 7 semester): Sp	•	•	Elective Compulsory
	General Engineering Science (English program): Specialisation		3, -,	1
	General Engineering Science (English program): Specialisation		stems: Compulsory	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp	·	-	Elective Compulsory
	Naval Architecture: Core qualification: Compulsory	3 - 3,	<b>3</b> , , -	, ,
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

Course L0235: Computational Fluid Dynamics I		
Тур	ure	
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.	
	1. Partial differential equations 2. Foundations of finite numerical approximations 3. Constability of partial figures.	
	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 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"			
Educational Objectives	After taking part successfully, students have reached the	he following learning results		
<b>Professional Competence</b>				
Knowledge	The students can evaluate the development of the ele	ectricity demand and the energy conversion routes	in the thermal power p	lant, describe the vario
	types of power plant and the layout of the steam gen-			
	describe the exhaust gas cleaning apparatus and ot fossil-fuelled power plants and regenerative (solar, win			ssibilities of convention
	The students can on a basic level explain principles,	operation and design of turbomachinery. They are	e able to describe the	environmental impacts
	acidification, fine particulate or CO <sub>2</sub> emissions and th	ne resulting climatic effects. They are able to name	e and discuss the chal	lenges in plant operati
	from interconnecting conventional power plants and	renewable energy sources and can name the op-	timal technical options	for providing security
	supply and network stability, also with economics cons	sidered.		
Skills	The students are able, using theories and methods	of the energy technology from fossil fuels and b	ased on deep knowle	dge on the function a
	construction of gas and steam power plants, to ider			
	solutions. Through analysis of the problem and expo			
	endowed with the capability and methodology to de	velop realistic optimal concepts for the environm	entally benign genera	tion of electricity and t
	production of heat. From the technical basics the students become the ability to follow better the deliberations on the electricity mix composition with			
	the energy-political triangle (economy, secure supply a	and environmental protection).		
	The students are able to highlight aspects of the	design and development of power plant cycles	with the specialised	software suite FBSII (
	Professional <sup>TM</sup> and to independently program simplifie		with the openianoed	Soliware Salic Ebole
	The students are able to do simplified calculations of to		vidual stanes	
		and the second s	riadai olagoo.	
Personal Competence	The students are able to calve subject aposific eversion	on in smalle groupe and can present their common	rogulto orally	
Social Competence	The students are able to solve subject-specific exercis	es in smans groups and can present their common	rresults orally.	
	The students are able to analyze suitable technical a	alternatives to reduce the environmental and soci	al footprint of their eng	ineering activities and
	support the energy revolution effectively.			
Autonomy	The students assisted by the tutors will be able to de	evelop alone simple simulation models and run w	ith these scenario ana	lyses. In this manner t
	theoretical and practical knowledge from the lecture	e is consolidated and the potential effects from	different process com	binations and bounda
	conditions highlighted. The students are able to ana	alyse independently the operational performance	of steam power plant	s and calculate select
	quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	0		
Credit points	6		-	-
Examination	Written exam			
Examination duration and scale	Written examination of 120 min			
Assignment for the Following	General Engineering Science (German program): Spe	**		
Curricula	General Engineering Science (German program): Spe			
	General Engineering Science (German program, 7 ser			
	General Engineering Science (German program, 7 ser		ocus Energy Systems:	Elective Compulsory
	Energy and Environmental Engineering: Core qualification		0	
	General Engineering Science (English program): Spec			
	General Engineering Science (English program): Spec			.,
	General Engineering Science (English program, 7 sen			
	General Engineering Science (English program, 7 sen Mechanical Engineering: Specialisation Energy System		ious Elieldy Systems: F	recave Compulsory
	woonamoa Engineening. Specialisation Energy System	mo. Compulacity		



L0206: Gas and Steam Powe	r 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
	WiSe
	In the 1 <sup>st</sup> part of the lecture an overview on thermal power plants is offered, including:
	in the 1" part of the recture an overview of 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 shermal 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 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
	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 discuss 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.
	A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with
	whole subject field of gas and steam power plants. Through discussions with plant personnel the students are able to obtain an overview on c
	operation problems and their solution approach.
	This activity hinges, however, upon the availability of support financing and as such it cannot always be guaranteed.
Literature	
	Kalide: Kraft- und Arbeitsmaschinen
	<ul> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> </ul>
	<ul> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> </ul>

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Hrs/wk	Recitation Section (large)
	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
	<ul> <li>Design examples of reciprocating engines and turbomachinery</li> </ul>
	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 afterware
	ask questions and get feedback. The course work has a positive effect on the students final grade.
Literature	a Christa
	Kelida Kraft und Arbeitsmagebingen
	Kalide: Kraft- und Arbeitsmaschinen     Thomas H. I.: Thormische Kraftenlagen, Springer Verlag, 1995.
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985     Stroug, K.: Kraftworkstochnik, Springer, Verlag, 2006
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugalar und Phlippan: Engreistochnik Springer Vorlag 1000
	<ul> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technische</li> </ul>



Module M0684: Heat Transf	fer			
Courses				
Title		Tun	Hrs/wk	CP
		Typ Lecture	3	5
Heat Transfer (L0458) Heat Transfer (L0459)		Recitation Section (large)	2	1
Module Responsible	Dr. Andreas Moschallski	ricollation occiton (large)	2	
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	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 of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss in small groups and develop an approximation of the students are able to discuss and develop an approximation of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the students are also approximated as a second discussion of the second discussion	pproach.		
Autonomy	The students are able to develop a complex problem self-consister	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 M			
Curricula	General Engineering Science (German program): Specialisation M		ystems: Compulsory	
	General Engineering Science (German program): Specialisation Bi		al Marahamita al Espaira	
	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): S Compulsory	pecialisation Mechanical Engineering,	rocus meoretical i	lechanical Engineening.
		sialisation Riemodical Engineering: Com	nulcon	
	General Engineering Science (German program, 7 semester): Spec General Engineering Science (English program): Specialisation Bio		ipaisory	
	General Engineering Science (English program): Specialisation Me		nice: Compulsory	
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program): Specialisation Me			ering: Compulsory
	General Engineering Science (English program, 7 semester): Spec		-	
	General Engineering Science (English program, 7 semester): Spec			
	Compulsory	para and an angliconing,		
	General Engineering Science (English program, 7 semester): Spec	ialisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compuls		-	
	Mechanical Engineering: Specialisation Theoretical Mechanical Er	gineering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, 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	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1022: Reciprocati	ing Machinery			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0633)		Lecture	1	1
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0634)		Recitation Section (large)	1	1
Internal Combustion Engines I (L0059)		Lecture	2	2
Internal 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	earning results		
Professional Competence				
Skills  Personal Competence  Social Competence	As a result of the part module "Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals regarding power and working machinery and describe the qualitative and quantitative correlations of operating methods and efficiencies of multiple types of engines, compressors and pumps. They are able to utilize technical terms and parameters as well as aspects regarding the development of power density and efficiency, furthermore to give an overview of charging systems, fuels and emissions. The students are able to select specific types of machinery and assess design related and operational problems.  As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design.  The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design.  The students are able to communicate and cooperate in a professional environment in the field of machinery design and application.			
	The widespread scope of gained knowledge enables the students	to handle situations in their future profe	ssion independently a	nd confidently.
	, , ,			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation M	echanical Engineering, Focus Energy	Systems: Compulsory	
Curricula	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Fo	cus Energy Systems: 0	Compulsory
	General Engineering Science (English program): Specialisation Me	echanical Engineering, Focus Energy S	Systems: Compulsory	
	General Engineering Science (English program, 7 semester): Spec	ialisation Mechanical Engineering, Foo	cus Energy Systems: C	ompulsory
	Mechanical Engineering: Specialisation Energy Systems: Compuls	ory		



Course L0633: Fundamentals of Rec	ciprocating Engines and Turbomachinery - Part Reciprocating Engines
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Christopher Friedrich Wirz
Language	DE
Cycle	WiSe
Content	
	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	Fraines I
	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Wolfgang Thiemann
Language	
	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	Calculation of tasks to:
	Design of of motors     Real process calculation     Charging methods     Kinematics of the crank mechanism     Forces in the engine
Literature	Vorlesungsskript



## **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			Heated	0.0
<b>Title</b> Advanced Mechanical Engineering Desigr	JI (10364)	Typ 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 I (L0263) Recitation Section (large) 2 1				1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Machanical Engineering Design			
Knowledge	Fundamentals of Mechanical Engineering Design     Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
	The second secon			
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and functions of m	achine elements and of basic elements of flui	dics.	
	explain requirements, selection criteria, application sc			
	<ul> <li>indicate the background of dimensioning calculations.</li> </ul>		•	
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered made	hine elements,		
	<ul> <li>transfer knowledge learned in the module to new requ</li> </ul>	irements and tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings and scher</li> </ul>	natic sketches,		
	<ul> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	Students are able to discuss technical information in the	ne lecture supported by activating methods.		
A. t				
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	ion 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): Specialisat			Compulsory
Credit points Examination Examination duration and scale	6 Written exam 120 General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Aircraft S	ystems Engineering:	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat	on Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials	ystems Engineering: in Engineering Scien	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Aircraft S ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro	ystems Engineering: in Engineering Scien nics: Compulsory	nces: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Aircraft S ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion 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): Specialisat	ion Mechanical Engineering, Focus Aircraft S ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion 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): Specialisat	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic	ystems Engineering: ( in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E	duction: Compulsory eering: Compulsory ngineering: Compulsor
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic	ystems Engineering: ( in Engineering Scier nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E	duction: Compulsory eering: Compulsory ngineering: Compulsor
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Door Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Focus Theoretic Specialisation Mechanical Engineering, Focus Focus Inserting Inserting	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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester) Compulsory	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Edon Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion	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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester) Compulsory  General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Edon Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion	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): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Ion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretical Engineering, Ion Specialisation Mechanical Engineering, Ion Specialisation Mechanical Engineering, Ion Mechanical Eng	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 in Engineering Science inpulsory opment and Production
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Ion Mechan	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): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering Focus: Specialisation Mechanical Engineering, Focus: Specialisation Mechanical Engineering, Ion Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Mechanical E	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E III, Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment and Production Mechanical Engineerin mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering Focus: Specialisation Mechanical Engineering, Focus: Specialisation Mechanical Engineering, I Specialisation Mechanical Engineering, I Specialisation Mechanical Engineering, Focus Focus Methanical Engineering, Focus Focu	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment and Production Mechanical Engineerin mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Ion Specialisation Mechanical Engineering, Ion Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Energy Symptosis Individual Engineering Individual E	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co stems: Compulsory	duction: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Energy Syon Mechanical Engineering, Focus Aircraft Syon	ystems Engineering: in Engineering Scien in Engineering Scien incs: Compulsory Development and Proal Mechanical Engineus Aircraft Systems Engineus Mechatronics: Corfocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corstems: Compulsory stems Engineering: Corstems: Compulsory	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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering Focus Product Dion Mechanical Engineering Focus Theoretic Specialisation Mechanical Engineering Focus Product Dion Mechanical Engineering Focus Product Dion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Production Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials Engineering, Focus Materials Engineering, Focus Materials	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Ce 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering Focus Theoretic Specialisation Mechanical Engineering Focus Theoretic Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials on Mechanical Engineering, Focus Materials on Mechanical Engineering, Focus	ystems Engineering: in Engineering Scien 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Product Den Mechanical Engineering,	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: C stems: Compulsory stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc	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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati	tion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretical Engineering	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: C rstems: Compulsory stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc 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): Specialisat General Engineering Science (German program, 7 semester): General Engineering Science (English program): Specialisati General Engineeri	ion Mechanical Engineering, Focus Aircraft Sylon Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretica Specialisatio	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Ci in Engineering Scien nics: Compulsory evelopment and Proc 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester): General Engineering Science (English program, 7 semester): General Engineering Science (English program, 7 semester):	ion Mechanical Engineering, Focus Aircraft Sylon Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretica Specialisatio	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Ci in Engineering Scien nics: Compulsory evelopment and Proc 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):	ion Mechanical Engineering, Focus Aircraft Sylon Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Product Don Mechanical Engineering	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E n, Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co rstems: Compulsory stems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er n, Focus Materials in	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory dechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory ngineering: Compulsory a Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):	tion Mechanical Engineering, Focus Aircraft Sylon Mechanical Engineering, Focus Materials from Mechanical Engineering, Focus Mechatro from Mechanical Engineering, Focus Product Description Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Specialisation Mecha	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co restems: Compulsory restems: Compulsory restems: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er procus Materials in us Mechatronics: Com us 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 ngineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):	tion Mechanical Engineering, Focus Aircraft Sylon Mechanical Engineering, Focus Materials from Mechanical Engineering, Focus Mechatro from Mechanical Engineering, Focus Product Description Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Specialisation Mecha	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co restems: Compulsory restems: Compulsory restems: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er procus Materials in us Mechatronics: Com us Materials in	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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):	tion Mechanical Engineering, Focus Aircraft Ston Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Ty: Specialisation Mechan	ystems Engineering: in Engineering Scien nics: Compulsory Development and Pro al Mechanical Engine us Aircraft Systems E procus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co restems: Compulsory restems: Compulsory restems Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er procus Materials in us Mechatronics: Com 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 Decign 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
	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.
	<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>
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.      Maching and August 1.0. Schlagt B. Brange Volder, 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.      Delet Match Maschinenelemente - With L. L. Maha P. Janzanah P. Valish, J. Springer-Verlag, aktuelle Auflage.      Delet Match 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		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	Advanced Mechanical Engineering Design I & II	
	Lecture	
	Fundamentals of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	Seals	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	Crank drives	
	Sliding bearings	
	Elements of fluidics	
	Exercise	
	Calculation methods of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	Clutches & brakes	
	Belt & chain drives	
	• Gear drives	
	Epicyclic gears	
	• Crank gears	
	Sliding bearings	
	Calculations of hydrostatic systems (fluidics)	
Literature		
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.	
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>	
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Total Control Contr	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.	
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.	
	Sowie weitere Bücher zu speziellen Themen	

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



courses				
itle		Тур	Hrs/wk	CP
dvanced Mechanical Design Project (L0)	266)	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	ng 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 possibiliti	es,		
	<ul> <li>explain guidelines for designing for function and manufacturing,</li> </ul>	,		
	explain advanced use-oriented knowledge of machine elements			
Skills	After passing the module, students are able to:			
	<ul> <li>analyze complex tasks and develop principle solutions using ske</li> </ul>	tches,		
	convert principle solutions into a detailed design,			
	<ul> <li>use methods to design and solve engineering design tasks syste</li> </ul>	matically and solution-oriented	i,	
	create a technical documentation including all necessary technic	al 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:			
	<ul> <li>present and discuss solutions and technical drawings within ground</li> </ul>	ıps,		
	<ul> <li>reflect the own results in the work groups of the course</li> </ul>			
Ata.m.a.m	After a section the ground of a set of section and a section and			
Autonomy	After passing the module, students are able to:			
	<ul> <li>independently solve complex design projects, while motivating the</li> </ul>	nemselves, acquiring necessar	y knowledge and selectin	g appropriate method
	to independently solve problems.			
Workload in Hours	Independent Study Time 194 Study Time in Leature ES			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specialisation Mecha	nical Engineering Focus Aircra	aft Systems Engineering:	Compulsory
Curricula	General Engineering Science (German program): Specialisation Mecha			
041110414	General Engineering Science (German program): Specialisation Mecha			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Special		•	
	Compulsory	ŭ		
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineer	ring, Focus Theoretical M	Mechanical Engineeri
	Compulsory			
	General Engineering Science (English program): Specialisation Mechar	nical Engineering, Focus Aircra	ft Systems Engineering: 0	Compulsory
	General Engineering Science (English program): Specialisation Mechan	nical Engineering, Focus Produ	ict Development and Proc	luction: Compulsory
	General Engineering Science (English program): Specialisation Mechar	nical Engineering, Focus Theor	etical Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisa	tion Mechanical Engineering,	Focus Aircraft Systems Er	igineering: Compulso
	General Engineering Science (English program, 7 semester): Special	isation Mechanical Engineering	ng, Focus Product Devel	opment and Producti
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineer	ing, Focus Theoretical M	Mechanical Engineeri
	Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			



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	



d Design of Mechatronic Systems			
	Тур	Hrs/wk	CP
s (L1822)	Lecture	2	2
s (L1824)	Laboratory	1	2
s (L1823)	Recitation Section (large)	1	2
of. Uwe Weltin			
one			
indatmentals of mechanics, control theory and electrical er	ngineering		
ter taking part successfully, students have reached the follo	owing learning results		
udents are able to describe methods and calculations for c	design, modeling, simulation and optimization	of mechatronic system	ns.
	ng of mechatronic systems. They can identi	ify, simulate and des	ign simple systems and
plement those in laboratory conditions.			
udents are able to work goal-oriented in small mixed group	os and present results to target groups		
such a die able to werk gear enemed in email mixed group	so and procent rocatio to target groups.		
Students are able to recognize and improve knowledge deficits independently.			
ith instructor assistance, students are able to evaluate their	r own knowledge level and define a further co	ureo of study	
<u>'</u>	Town knowledge level and define a further con	urse or study.	
Jependent Study Time 124, Study Time in Lecture 56			
	<del> </del>		
	• •		
		-	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:			
ective Compulsory			
eneral Engineering Science (English program): Specialisa	tion Mechanical Engineering, Focus Aircraft S	ystems Engineering: 0	Compulsory
eneral Engineering Science (English program): Specialisa	tion Mechanical Engineering, Focus Mechatro	nics: Compulsory	
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory			
eneral Engineering Science (English program, 7 semester	: Specialisation Mechanical Engineering, Foc	us Mechatronics: Con	npulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory			
eneral Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engineering	, Focus Theoretical I	Mechanical Engineering
ective Compulsory			
echanical Engineering: Specialisation Aircraft Systems En	gineering: Compulsory		
echanical Engineering: Specialisation Mechatronics: Com-	pulsory		
echanical Engineering: Specialisation Theoretical Mechan	ical Engineering: Compulsory		
	ter taking part successfully, students have reached the followed on the content of the content o	ter taking part successfully, students have reached the following learning results  udents are able to describe methods and calculations for design, modeling, simulation and optimization udents are able to apply modern algorithms for modeling of mechatronic systems. They can ident uplement those in laboratory conditions.  udents are able to work goal-oriented in small mixed groups and present results to target groups.  udents are able to recognize and improve knowledge deficits independently.  iith instructor assistance, students are able to evaluate their own knowledge level and define a further codependent Study Time 124, Study Time in Lecture 56  ritten exam  o min  eneral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatroneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Programs eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Procus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Procus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus eneral Eng	Lecture 2 (L1822) Laboratory 1 (Laboratory 1

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 M0599: Integrated F	Product Development and Lightweight Design	1		
Courses				
Title CAE-Team Project (L0271) Development of Lightweight Design Produc	cts (L0270)	Typ Problem-based Learning Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 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 follow	ring learning results		
Professional Competence	After completing the module of ideate are sealing.			
Knowledge	After completing the module, students are capable of:			
	explaining the functional principle of 3D-CAD-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:			
	<ul> <li>evaluate different CAD- and PDM-Systems with regards</li> <li>design an exemplary product using CAD-,PDM- and/or</li> </ul>		ication schemes and	product structuring
Personal Competence				
Social Competence	After completing the module, students are able to:			
	To develop a project plan and allocate work appropriat	e work packages in the framework of group	discussions	
	Present project results as a team for instance in a present	entation		
Autonomy	Students are capable of:			
	<ul> <li>independently adapt to a CAE-Tool and complete a giv</li> </ul>	en practical task with it		
		on praduodi taok with it		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points  Examination	6 Written exam			
Examination Examination	90			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Mechanical Engineering, Focus Aircraft S	ystems Engineering: (	Compulsory
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester):		,	,
	General Engineering Science (German program, 7 semester Compulsory	r): Specialisation Mechanical Engineering,	Focus Product Devel	opment and Production
	General Engineering Science (English program): Specialisation	n Mechanical Engineering, Focus Aircraft Sy	rstems Engineering: C	Compulsory
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Product D	evelopment and Proc	luction: Compulsory
	General Engineering Science (English program, 7 semester):		,	,
	General Engineering Science (English program, 7 semester Compulsory	): Specialisation Mechanical Engineering,	Focus Product Devel	opment and Production
	Mechanical Engineering: Specialisation Product Development	and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems Engin	neering: Compulsory		
	Product Development, Materials and Production: Technical Co	implementary Course Core Studies: Elective	Compulsory	



Course L0271: CAE-Team Project	
Тур	Problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<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	tweight Design Products
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
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>	



Module M0767: Aeronautic	al Systems			
Courses				
Title		Тур	Hrs/wk	СР
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	following learning results		
Professional Competence				
Knowledge				
	knowledge of the relationchips, the key parameters, role	s and ways of working in different subsystems in	the air transport is acq	uired.
Skills	Due to the learned cross-system thinking students	can gain a deeper understanding of different	system concepts an	d their technical system
	implementation. In addition, they can apply the learned			•
	context of the overall system.	•	,	,
Personal Competence				
Social Competence	Students are made aware of interdisciplinary communic	ation in groups.		
Autonomy	Students are able to independently analyze different sys	tem concepts and their technical implementation	as well as to think sys	tem oriented.
	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	General Engineering Science (German program): Speci	alisation Mechanical Engineering, Focus Aircraft	Systems Engineering:	Compulsory
Curricula	General Engineering Science (German program, 7 semi			
34.110414	General Engineering Science (English program): Specia	, ,	,	0 0 1 ,
	General Engineering Science (English program, 7 seme	* *		
	Logistics and Mobility: Specialisation Logistics and Mob			
	Mechanical Engineering: Specialisation Aircraft Systems	• •		
		2 Linguisting, Company		

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>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
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	Practical exercises to understand
Literature	aircraft movement in wind conditions     aircraft performance analyses     radio navigation prinicples  Objective: Understanding and application of principle methods to practical aviation problems  Hünnecke: Das moderne Verkehrsflugzeug von heute
Literature	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		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	<ul> <li>Fundamentals of Mechanical Engineering Design</li> </ul>			
ougo	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:			
	explain complex working principles and functions of machine eler	ments and of basis elements of fluid	00	
	explain requirements, selection criteria, application scenarios and     indicate the head ground of dispensioning adductions.	practical examples of complex mad	mine 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 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>	ies,		
	<ul> <li>evaluate complex designs, technically.</li> </ul>			
Davidanal Compostorio				
Personal Competence				
Social Competence	Students are able to discuss technical information in the lecture su	upported by activating methods.		
Autonomy	Students are able to independently deepen their acquired knowle	in evercises		
	Students are able to acquire additional knowledge and to reca		t a.a. by using the	video recordings of the
	lectures.	apitulate poorly understood conten	t e.g. by using the	video recordings or the
	iectures.			
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 Mechan	ical Engineering Feets Energy Sys	tome: Compulsory	
Curricula				Compulson
Curricula	General Engineering Science (German program): Specialisation Mechan			
	General Engineering Science (German program): Specialisation Mechan General Engineering Science (German program): Specialisation Mechan			ces. Compulsory
	General Engineering Science (German program): Specialisation Mechan	•		duction: Compulari
	General Engineering Science (German program): Specialisation Mechan		•	
		•	-	
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specia	ansauon wechanical Engineering,	i ocus ivialeriais In	Engineering Sciences:
	Compulsory	March and a Francisco Francisco		and the same
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Speciali	sation Mechanical Engineering, Fo	icus Product Devel	opment and Production:
	Compulsory			
	General Engineering Science (German program, 7 semester): Special	lisation Mechanical Engineering, F	ocus Theoretical N	Mechanical Engineering:
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisa	tion Mechanical Engineering, Focus	Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester): Specialisa	tion Mechanical Engineering, Focus	Energy Systems: C	Compulsory
	General Engineering Science (English program): Specialisation Mechani	ical Engineering, Focus Energy Sys	tems: Compulsory	
	General Engineering Science (English program): Specialisation Mechani	ical Engineering, Focus Aircraft Sys	ems Engineering: C	Compulsory
	General Engineering Science (English program): Specialisation Mechani	ical Engineering, Focus Materials in	Engineering Science	ces: Compulsory
		ical Engineering Focus Mechatronia		
	General Engineering Science (English program): Specialisation Mechani	ical Engineering, rocas Mechalionii	cs: Compulsory	
	General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program): Specialisation Mechani			luction: Compulsory
		ical Engineering, Focus Product De	velopment and Prod	
	General Engineering Science (English program): Specialisation Mechani	ical Engineering, Focus Product Derical Engineering, Focus Theoretical	velopment and Prod Mechanical Engine	ering: Compulsory
	General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program, 7 semester): Specialisat	ical Engineering, Focus Product Derical Engineering, Focus Theoretical ion Mechanical Engineering, Focus	velopment and Prod Mechanical Engine Aircraft Systems En	ering: Compulsory
	General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Special	ical Engineering, Focus Product Derical Engineering, Focus Theoretical ion Mechanical Engineering, Focus	velopment and Prod Mechanical Engine Aircraft Systems En	ering: Compulsory
	General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program, 7 semester): Specialisati General Engineering Science (English program, 7 semester): Special Compulsory	ical Engineering, Focus Product De- ical Engineering, Focus Theoretical ion Mechanical Engineering, Focus Ilisation Mechanical Engineering,	velopment and Prod Mechanical Engine Aircraft Systems En Focus Materials in	ering: Compulsory igineering: Compulsory Engineering Sciences:
	General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program): Specialisation Mechani General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Special	ical Engineering, Focus Product De- ical Engineering, Focus Theoretical ion Mechanical Engineering, Focus Ilisation Mechanical Engineering, ion Mechanical Engineering, Focus	velopment and Prod Mechanical Engine Aircraft Systems En Focus Materials in Mechatronics: Com	ering: Compulsory igineering: Compulsory 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 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
Content	Advanced wechanical Engineering Design ( & 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 (nutrices)
Literature	Debut Took of the Markington Color Kill Tolling and Idlay Color Marking the Color
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.  Machine ausgesche Besch W. Nieuwen, G. Gerinen Machine, auch all. A. fleuer.  Machine ausgesche Besch W. Nieuwen, G. Gerinen M. Machine, auch all. A. fleuer.  Die 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.  Ti (The provided in Park No. 1) And Andrews (Andrews of the Park No. 1) Andrews (Andrews of the Park No
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Auf der Aufliche Bilde Din Bilde Die Belle Die Be
	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
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	<ul> <li>Sliding bearings</li> </ul>
	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 Treebenhab Stades Marchinghou Costs V. H. Feldhare 1915 - Colon Webs 1915 A. Sec.
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.      Maschinenble Bend Lilly Niemann C. Corinen Verlag, although Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.      Maschinene und Kenthultingscharpster Chickiller W. Pinger B. Springer Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.      Fieffigure in die DIN Negroep Krein M. Trubes Verlag.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Kopatruktionelebre Bahl, C. Beitz, W. Springer, Verlag, aktuelle Auflage.      Kopatruktionelebre Bahl, C. Beitz, W. Springer, Verlag, aktuelle Auflage.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.  Macchingagiomenta 1.2: Schlacht B. Pagger Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.  Maschinenelemente Castelling Paracharus Asunadura Unbaharus II. Badasatsia F. Carianas Vadas altisulla Auflaga.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      Poleff Match Masching a glass at the Mittel H. Mittel B. Lagrangh B. Verlick H. Caringa a Visual a 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 M0988: Structural N	Materials			
Courses				
Title		Тур	Hrs/wk	СР
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 reach	ed the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are re	esponsible for the mechanical behaviour of metals	. They acquire basic knowl	egde in modelling of the
	materials behaviour. Furthermore, the students le	arn about the behaviour of metals under static and	I dynamic loads. The stude	nts get to know the most
	important welding technologies and the correspon	nding systems. They learn about the influence of we	lding on the materials and	design.
Skills	The students know the mechanical properties of	metals and the underlying principles. They are al	ble to name the influencin	a factors on the welding
C.I.II.C	behaviour of steel materials.	metale and the anaenying principles. They are a		g lactors on the moraling
	·	ccording to the desired mechaincal properties and		-
	•	ique and system components for a defined applica	ation. 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 Lectu	re 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Mat	terials in Engineering Scier	ices: Compulsory
Curricula	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical Engine	eering, Focus Materials in	Engineering Sciences
	Compulsory			
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Mate	erials in Engineering Scien	ces: Compulsory
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical Engine	eering, Focus Materials in	Engineering Sciences
	Compulsory			
	Mechanical Engineering: Specialisation Materials	in Engineering Sciences: Compulsory		

Course L1090: Fundamentals of Med	chanical Properties of Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Norbert Huber, 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)
	randon. Conplain maleinalineone offinatistune (1930)
	P. Haupt: Cont. Mechanics and Theory of Materials (2002)



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.



Module M0662: Numerical	Mathematics I			
Courses				
Title		Typ	Hrs/wk	CP
Numerical Mathematics I (L0417)		<b>Typ</b> Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
	None			
Admission Requirements Recommended Previous	Notice			
Knowledge	Mathematik I + II for Engineering Students (german or e     basic MATLAB knowledge	english) <b>or</b> Analysis & Linear Algebra I + II for	Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached the follow	ving 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 meth     explain aspects for the practical execution of numerical	ods,		finding problems and to
Skills	Students are able to			
	implement, apply and compare numerical methods usi     justify the convergence behaviour of numerical method     select and execute a suitable solution approach for a g	Is with respect to the problem and solution al	gorithm,	
Personal Competence				
Social Competence	Students are able to			
,				
	<ul> <li>work together in heterogeneously composed teams (i foundations and support each other with practical aspe</li> </ul>			edge), explain theoretica
Autonomy	Students are capable			
	to assess whether the supporting theoretical and practi     to assess their individual progess and, if necessary, to		or in a team,	
Workload in House	Independent Study Time 194 Study Time in Leature ES			
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	on Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	on Mechanical Engineering, Focus Materials	in Engineering Scien	nces: Compulsory
	General Engineering Science (German program): Specialisation	on Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester):	Specialisation Computer Science: Compulso	ory	
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineering	, Focus Materials in	n Engineering Sciences
	Compulsory			
	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering, Foc	us Biomechanics: Co	mpulsory
	Bioprocess Engineering: Specialisation A - General Bioproces			
	Computer Science: Specialisation Computational Mathematics	· ·		
	Electrical Engineering: Core qualification: Elective Compulsor	•		
	General Engineering Science (English program): Specialisation	, ,		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			ices: Compulsory
	General Engineering Science (English program, 7 semester):	·	•	
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engineering	, Focus Materials in	n Engineering Sciences
	Compulsory			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):		us Biomechanics: Co	mpulsory
	Computational Science and Engineering: Core qualification: C			
	Process Engineering: Specialisation Process Engineering: Ele	ective Compulsory		



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



Module M1009: Material Sc	ence Laboratory			
Courses				
Title		Тур	Hrs/wk	СР
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)		Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of exp	eriments in the area of materials scie	nces and illustrate respe	ective relationships. The
	are capable of describing and communicating relevant problems	s and questions using appropriate te	echnical language. The	can explain the typica
	process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on materi	ial sciences to the process of solving	practical problems. The	ov identify and overcome
Skills	typical problems during the realization of experiments in the context		practical problems. The	by identity and overcome
	typical problems during the realization of experiments in the contex	kt of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are able to effectively present			
	and explain their results alone or in groups in front of a qualified at	udience.		
Autonomy	Students are capable of solving problems in the context of mater	ials sciences using provided literatur	re. They are able to fill o	nans in as well as exten
nation only	their knowledge using the literature and other sources provided by	• •	io. moj aro abio to im t	japo III do Woll do oxion
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 N	Mechanical Engineering, Focus Materi	als in Engineering Scier	nces: Compulsory
Curricula	General Engineering Science (German program): Specialisation N			
	General Engineering Science (German program, 7 semester):	-	•	
	Compulsory	•		
	General Engineering Science (English program): Specialisation M	echanical Engineering, Focus Materia	als in Engineering Scien	ces: Compulsory
	General Engineering Science (English program): Specialisation M	echanical Engineering, Focus Produc	ct Development and Prod	duction: Compulsory
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences
	Compulsory			
	Mechanical Engineering: Specialisation Product Development and	Production: Compulsory		
	Mechanical Engineering: Specialisation Materials in Engineering S	Sciences: Compulsory		
	Product Development, Materials and Production: Technical Compl	ementary Course Core Studies: Electi	ive Compulsory	

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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	Trindin 5. Gainstel and Savid G. Healtwisen, material wissersonialited and Weinstellink, Wheyacours, 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	



Module M1005: Enhanced I	Fundamentals of Materials Science				
Courses					
Title		Тур		Hrs/wk	CP
Fundamentals of Metallic Materials (L1086	•	Lectur		2	3
Fundamentals of Ceramic and Polymer Ma		Lectur		2	2
Fundamentals of Ceramic and Polymer Ma	aterials (L1234)	Recita	tion Section (large)	1	1
Module Responsible	Prof. Gerold Schneider				
Admission Requirements	None				
Recommended Previous	Module "Fundamentals of Materials Science"				
Knowledge	Module "Materials Science Laboratory"				
	Module "Advanced Materials"				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students are able to give an enhanced overview	over the following topics			
	in metals, polymers and ceramics: Atomic bonds, c	rystal and amorphous structu	res, defects, electrical	and mass transport, n	nicrostructure and phase
	diagrams. They are capable to explain the correspon	nding technical terms.			
Skills	The students are able to apply the appropriate physi	cal and chemical methods for	the above mentioned so	ubjects.	
D					
Personal Competence					
Social Competence					
Autonomy	The students are capable to understand independent	ently the structure and propet	ies of ceramics, metals	and polymers. They s	should be able to critally
	evaluate the profoundness of their knowledge.				
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): Sp	pecialisation Mechanical Engi	neering, Focus Materials	s in Engineering Scier	ces: Compulsory
Curricula	General Engineering Science (German program,	-	•		
	Compulsory				
	General Engineering Science (German program, 7	semester): Specialisation M	echanical Engineering.	Focus Product Devel	opment and Production:
	Compulsory		5 9,		
	General Engineering Science (English program): Sp	ecialisation Mechanical Engir	neering, Focus Materials	in Engineering Scien	ces: Compulsory
	General Engineering Science (English program,	-	-		
	Compulsory				- 0
	General Engineering Science (English program, 7	semester): Specialisation Me	echanical Engineering.	Focus Product Devel	opment and Production
	Compulsory	•	3 3,		
	Mechanical Engineering: Specialisation Materials in	Engineering Sciences: Comp	ulsory		
	Technomathematics: Specialisation III. Engineering		•		
	Technomathematics: Core qualification: Elective Cor				
	·	· · · · · · · · · · · · · · · · · · ·			

Course L1086: Fundamentals of Metallic Materials		
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		
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 I 1000: Fundamentals of Co	newig and Dahman Materials
Course L1233: Fundamentals of Ce	
Typ Hrs/wk	Lecture 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
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten
	Bruchzähigkeit – Linear-elastische Bruchmechanik
	Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften
	Anwendungen
	Veremiasha langulaiter
	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
	555 5 50
	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
	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: Fundamentals of Ceramic and Polymer Materials	
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



## **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.

	nted master study.			
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Mechanical Engineering Design II (L0264) Lecture 2			2	2
Advanced Mechanical Engineering Design II (L0265) Recitation Section (large) 2			2	1
anced Mechanical Engineering Design I (L0262)  Lecture 2			2	
Advanced Mechanical Engineering Design				
Module Responsible				
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 follo	wing learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and functions of n	achine elements and of basic elements of flui	dics,	
	<ul> <li>explain requirements, selection criteria, application so</li> </ul>			
	indicate the background of dimensioning calculations			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered made.	chine elements,		
	<ul> <li>transfer knowledge learned in the module to new requ</li> </ul>	irements 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>			
Davasual Commissiones				
Personal Competence				
Social Competence	Students are able to discuss technical information in to	ne lecture supported by activating methods.		
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	nt e.g. by using the	video recordings of th
	lectures.			
	Indianadas Chulu Tima CO Chulu Tima in Lantuur 140			
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	ion 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): Specialisat			Compulsory
Credit points Examination Examination duration and scale	6 Written exam 120 General Engineering Science (German program): Specialisar General Engineering Science (German program): Specialisar	ion 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): Specialisar General Engineering Science (German program): Specialisar General Engineering Science (German program): Specialisar	ion Mechanical Engineering, Focus Aircraft Sylion Mechanical Engineering, Focus Materials	ystems Engineering: in Engineering Scien	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisar General Engineering Science (German program): Specialisar	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro	ystems Engineering: in Engineering Scien nics: Compulsory	ices: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisar	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D	ystems Engineering: in Engineering Scien nics: Compulsory development and Pro	duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 120 General Engineering Science (German program): Specialisar	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic	ystems Engineering: (in Engineering Scier nics: Compulsory levelopment 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): Specialisar	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Foc	vstems Engineering: (in Engineering Sciennics: Compulsory levelopment and Proal Mechanical Engineus 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): Specialisar	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Foc	vstems Engineering: (in Engineering Sciennics: Compulsory levelopment and Proal Mechanical Engineus 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): Specialisar General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Foc tter): Specialisation Mechanical Engineering	vstems Engineering: in Engineering Scier nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor In Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focuster): Specialisation Mechanical Engineering, Focuster): Specialisation Mechanical Engineering, Focus	ystems Engineering: in Engineering Scier nics: Compulsory levelopment and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focuster): Specialisation Mechanical Engineering, Focuster): Specialisation Mechanical Engineering, Focus	ystems Engineering: in Engineering Scier nics: Compulsory levelopment and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focus iter): Specialisation Mechanical Engineering, Focus : Specialisation Mechanical Engineering, Focus ion): Specialisation Mechanical Engineering, Focus	stems Engineering: in Engineering Scier nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Productio
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focus iter): Specialisation Mechanical Engineering, Focus : Specialisation Mechanical Engineering, Focus ion): Specialisation Mechanical Engineering, Focus	stems Engineering: in Engineering Scier nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science npulsory opment and Productio
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product D ion Mechanical Engineering, Focus Theoretic : Specialisation Mechanical Engineering, Focus ter): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering, Focus er): Specialisation Mechanical Engineering,	ystems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel	duction: Compulsory duction: Compulsory pering: Compulsory ingineering: Compulsor Engineering Science inpulsory opment and Productio Mechanical Engineerin
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisar General Engineering Science (German program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Ion Mechanical Engineering, Ion Mechanical Engine	ystems Engineering: in Engineering Scien in Engineering Scien incs: Compulsory development and Proal Mechanical Engineus Aircraft Systems E., Focus Materials in us Mechatronics: Corfocus Product Develous Theoretical Mechanics: Cous Biomechanics: Cous Energy Systems: Cous Energy Sys	duction: Compulsory duction: Compulsory pering: Compulsory ingineering: Compulsor ingineering Science inpulsory opment and Production Mechanical Engineerin impulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion Mechanical Engineering ion Mechanical Engineering ion; Specialisation Mechanical Engineering, Focus Energy Sy ion Mechanical Engineering, Focus Energy Sy	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: Co stems: Compulsory	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science mpulsory opment and Productio Mechanical Engineerin mpulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion Mechanical Engineering ion: Specialisation Mechanical Engineering, Focus Energy Sy on Mechanical Engineering, Focus Aircraft Sy on Mechanical Engineering, Focus Aircraft Sy	ystems Engineering: (in Engineering Scienties: Compulsory Development and Proal Mechanical Engineus Aircraft Systems E., Focus Materials in us Mechatronics: Corfocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corporation of the Corporation of	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science Inpulsory opment and Production Mechanical Engineerin Impulsory Compulsory Compulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion Mechanical Engineering ion Mechanical Engineering ion; Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Ion ion ion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Informatical Engineering, Focus Energy Sy on Mechanical Engineering, Focus Materials ion Mechanical Engi	stems Engineering: in Engineering Scienties: Compulsory development and Proal Mechanical Engineus Aircraft Systems E., Focus Materials in us Mechatronics: Corfocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corpus Engineering: Coin Engineering: Coin Engineering Scienties: Coenties Engineering: Coin Engineering Scienties: Coenties Engineering Scienties Engineering En	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science Inpulsory opment and Production Mechanical Engineerin Impulsory Compulsory Compulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati General Engineering Science	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion Mechanical Engineering ion Mechanical Engineering ion; Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Aircraft Sy on Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechanical Engineeri	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel us Biomechanics: Co us Energy Systems: Co stems: Compulsory stems Engineering: Ci in Engineering Scien nics: Compulsory	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor I Engineering Science Inpulsory opment and Production Mechanical Engineerin Impulsory Compulsory Compulsory Compulsory Compulsory Compulsory Compulsory Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisati General Engineering Science (English program): Specialisati General Engineering Science	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic: Specialisation Mechanical Engineering, Focus Theoretic ion Mechanical Engineering ion Mechanical Engineering ion Mechanical Engineering ion; Specialisation Mechanical Engineering, Focus Energy Sy on Mechanical Engineering, Focus Aircraft Sy on Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Din Mechanical Engineering, Focus	ystems Engineering: in Engineering Scientics: Compulsory development and Proal Mechanical Engineus Aircraft Systems E., Focus Materials in us Mechatronics: Corfocus Product Develous Energy Systems: Cous Energy Systems: Corporate Stems: Compulsory stems Engineering: Coin Engineering Scientics: Compulsory evelopment and Product in Engineering Scientics: Compulsory evelopment and Products: Compulsory evelopment and Products even even every evelopment evelopm	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor ngineering: Compulsor npulsory opment and Production Mechanical Engineerin mpulsory Compulsory Compulsory des: Compulsory duction: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisating General Engineering Science (English program): Spec	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Product Dion Mechanical Engineering Focus Theoretic Product Dion Mechanical Engineering Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretical En	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel us Biomechanics: Co us Energy Systems: Co us Energy Systems: Co in Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor in Engineering Science inpulsory opment and Production Mechanical Engineerin impulsory Compulsory Compulsory duction: 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisating General Engineering Science (English program): Spec	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Product Dion Mechanical Engineering Focus Theoretic Product Dion Mechanical Engineering Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Diecenterion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretical E	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co us Energy Systems: Co in Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor ngineering: Compulsor npulsory opment and Production Mechanical 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): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisating General Engineering Science (English program): Spe	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Product Dion Mechanical Engineering Focus Theoretic Product Dion Mechanical Engineering Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Diecenterion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretical E	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel  Focus Theoretical M us Biomechanics: Co us Energy Systems: Co us Energy Systems: Co in Engineering: Co in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er	duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsor ngineering Science npulsory opment and Productio Mechanical 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): Specialisat General Engineering Science (German program, 7 semester); General Engineering Science (English program): Specialisati General Engineeri	ion Mechanical Engineering, Focus Aircraft Sy ion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering (Septialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus On Mechanical Engineering, Focus Energy Sy on Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Product Don Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretical Engineering, Focus Theoretical Engineering, Focus Theoretical Specialisation Mechanical Engineering, Focus Theoretical Engine	stems Engineering: in Engineering Scientics: Compulsory development and Proal Mechanical Engineus Aircraft Systems E., Focus Materials in us Mechatronics: Corfocus Product Development and Proal Mechanics: Cous Energy Systems: Compulsory stems Engineering: Coin Engineering Scientics: Compulsory evelopment and Proal Mechanical Engineus Aircraft Systems Er, Focus Materials in Focus Materials in	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor negineering Science mpulsory opment and Productio Mechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory ngineering: Compulsory Engineering: Compulsory Engineering Science
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisating General Engineering Science (English program): Specialisating Compulsory General Engineering Science (English program): Specialisating Compulsory General Engineering Science (	ion Mechanical Engineering, Focus Aircraft Syion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Product Dion Mechanical Engineering Process Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: C us Energy Systems:	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor negineering Science mpulsory dechanical Engineerin mpulsory Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsory engineering: Compulsory engineering: Compulsory magineering: Compulsory engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (English program): Specialisating General Engineering Science (English program, 7 semester)	ion Mechanical Engineering, Focus Aircraft Syion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Product Dion Mechanical Engineering Process Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: C us Energy Systems:	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor negineering Science mpulsory dechanical Engineerin mpulsory Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsory engineering: Compulsory engineering: Compulsory magnineering: Compulsory engineering: Compulsory mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specialisat General Engineering Science (German program, 7 semester) General Engineering Science (German program): Specialisating General Engineering Science (English program): Specialisating Compulsory General Engineering Science (English program): Specialisating Compulsory General Engineering Science (	ion Mechanical Engineering, Focus Aircraft Syion Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechatro ion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Product Dion Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Theoretic Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Materials ion Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Theoretica Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Theoretical Specialisation Mechanical	stems Engineering: in Engineering Scien nics: Compulsory development and Pro al Mechanical Engine us Aircraft Systems E , Focus Materials in us Mechatronics: Cor Focus Product Devel Focus Theoretical M us Biomechanics: Co us Energy Systems: C us Energy Systems:	duction: Compulsory duction: Compulsory duction: Compulsory deering: Compulsory ngineering: Compulsor n Engineering Science mpulsory opment and Productio Mechanical Engineerin mpulsory Compulsory Compulsory duction: Compulsory duction: Compulsory reing: Compulsory ngineering: Compulsory agineering: Compulsory opment and Productio



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 Decign 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	
	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     Florente of fluiding	
	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.	
	<ul> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> </ul>	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.  Machine ald a Callaght B. Rayman Machine ald A. (August Machine)  Machine and Ma	
	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
	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 Rücher zu sneziellen Themen
	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 M0708: Electrical E	ingineering 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		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating	electrical circuits. They know the Fourie	r series analysis of li	near networks driven b
	periodic signals. They know the methods for transient analysis	of linear networks in time and in freque	ncy domain, and the	are able to explain th
	frequency behaviour and the synthesis of passive two-terminal-cir	rcuits.		
Skills	The students are able to calculate currents and voltages in linear	r networks by means of basic methods, a	lso when driven by p	eriodic signals. They ar
	able to calculate transients in electrical circuits in time and frequen	ncy domain and are able to explain the re	espective transient be	haviour. They are able t
	analyse and to synthesize the frequency behaviour of passive two	-terminal-circuits.		
Personal Competence				
Social Competence				
Autonomy	The students are able to find out the required methods for solving	the given practice problems. Possibilition	es are given to test th	eir knowledge during th
•	lectures continuously by means of short-time tests. This allows t	them to control independently their educ	ational objectives. Th	ney can link their gaine
	knowledge to other courses like Electrical Engineering I and Math		•	
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): Specialisation I	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation I	Mechanical Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engineering, Foo	cus Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 semester): Spe	ecialisation Electrical Engineering: Comp	oulsory	
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation E	Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation N	Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program, 7 semester): Spe	ecialisation Mechanical Engineering, Foc	us Mechatronics: Con	npulsory
	General Engineering Science (English program, 7 semester): Spe	ecialisation Electrical Engineering: Comp	ulsory	
	Computational Science and Engineering: Specialisation Engineer	ring Sciences: Elective Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elec			
	Technomathematics: Specialisation III. Engineering Science: Elec	tive 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



d Design of Mechatronic Systems			
	Тур	Hrs/wk	CP
s (L1822)	Lecture	2	2
Simulation and Design of Mechatronic Systems (L1824)  Laboratory 1			2
stems (L1823) Recitation Section (large) 1 2			2
Prof. Uwe Weltin			
None			
indatmentals of mechanics, control theory and electrical er	ngineering		
ter taking part successfully, students have reached the follo	owing learning results		
udents are able to describe methods and calculations for c	design, modeling, simulation and optimization	of mechatronic system	ns.
	ng of mechatronic systems. They can identi	ify, simulate and des	ign simple systems and
plement those in laboratory conditions.			
udents are able to work goal-oriented in small mixed group	os and present results to target groups		
such a die able to werk gear enemed in email mixed group	so and procent rocatio to target groups.		
Students are able to recognize and improve knowledge deficits independently.			
<u>'</u>	Town knowledge level and define a further con	urse or study.	
Jependent Study Time 124, Study Time III Lecture 56			
	<del> </del>		
	• •		
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 Theoretical Mechanical Engineering			
ective 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 Theoretical Mechanical Engineering: Compulsory			
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory			npulsory
eneral Engineering Science (English program, 7 semester	: Specialisation Mechanical Engineering, Foc	us Aircraft Systems Er	ngineering: Compulsory
eneral Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engineering	, Focus Theoretical I	Mechanical Engineering
ective Compulsory			
echanical Engineering: Specialisation Aircraft Systems En	gineering: Compulsory		
echanical Engineering: Specialisation Mechatronics: Com-	pulsory		
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory			
	of. Uwe Weltin  one undatmentals of mechanics, control theory and electrical er ter taking part successfully, students have reached the follo udents are able to describe methods and calculations for o udents are able to apply modern algorithms for modeli plement those in laboratory conditions.  udents are able to work goal-oriented in small mixed group udents are able to recognize and improve knowledge defice ith instructor assistance, students are able to evaluate their dependent Study Time 124, Study Time in Lecture 56  ritten exam  o min eneral Engineering Science (German program): Specialisa eneral Engineering Science (German program, 7 semester eneral Engineering Science (German program, 7 semester eneral Engineering Science (English program): Specialisa eneral Engineering Science (English program, 7 semester eneral Engineering Science (English progr	Lecture  Laboratory  Is (L1824)  Laboratory  Recitation Section (large)  of. Uwe Weltin  one  Indatmentals of mechanics, control theory and electrical engineering  ter taking part successfully, students have reached the following learning results  udents are able to describe methods and calculations for design, modeling, simulation and optimization  udents are able to apply modern algorithms for modeling of mechatronic systems. They can ident plement those in laboratory conditions.  udents are able to work goal-oriented in small mixed groups and present results to target groups.  udents are able to recognize and improve knowledge deficits independently.  ith instructor assistance, students are able to evaluate their own knowledge level and define a further co- dependent Study Time 124, Study Time in Lecture 56  ritten exam  o min  aneral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Seneral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Seneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Peneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Peneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Peneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Peneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Peneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretic  eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretic  eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretic  eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretic  eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretic  eneral Engi	Lecture 2 (L1822) Laboratory 1 (Laboratory 1

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	Prof. Wolfgang Krautschneider			
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Desire of physics			
	Basics of physics			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Objects are able to analytically the forest and the fill forest	at MOO design to all advantage to the		
	Students are able to explain the functionality of differe		ata a sa	
	Students know the fundamental digital logic circuits at			
	Students have solid knowledge about memory circuits     Students are able to explain how applied circuits functions.		lications.	
	Students are able to explain how analog circuits funct     Students know the expressions fields for the use of his			
	<ul> <li>Students know the appropriate fields for the use of bip</li> </ul>	iolar transistors.		
Chille				
Skills	Students can calculate the specifications of different N	MOS devices and can define the parameters of	of electronic circuits.	
	Students are able to develop different logic circuits and can design different types of logic circuits.			
	<ul> <li>Students can use MOS devices, operational amplifiers</li> </ul>	s and bipolar transistors for specific application	ins.	
Personal Competence				
Social Competence				
	Students are able work efficiently in heterogeneous te			
	Students working together in small groups can solve page.	problems and answer professional questions		
Autonomy	<ul> <li>Students are able to assess their level of knowledge.</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): Specialisa	tion Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa		onics: Compulsory	
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semester)			npulsory
	Computer Science: Specialisation Computer and Software En	ngineering: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisati	ion Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	ion Mechanical Engineering, Focus Mechatro	nics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester)	: Specialisation Mechanical Engineering, Foc	us Mechatronics: Con	pulsory
	Computational Science and Engineering: Specialisation Con	nputer Science: Elective Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Comp	oulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		



Course L0763: Semiconductor Circuit Dec Typ Lectu Hrs/wk 3	
Hrs/wk 3	cture
CP 4	
Workload in Hours Indep	lependent Study Time 78, Study Time in Lecture 42
Lecturer Prof.	of. Wolfgang Krautschneider
<b>Language</b> DE	
Cycle SoSe	Se
Content  Literature R. J. HG. K. Ho U. Ti H. G. 9783 URL: URL:	<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 behavior of BiCMOS circuits</li> <li>J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011, ISBN: 047170055S</li> <li>G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496</li> <li>Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 83642208867</li> <li>RL: http://dx.doi.org/10.1007/978-3-642-20887-4</li> <li>RL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>RL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955</li> <li>RL: http://www.ciando.com/img/bo</li> </ul>

Course L0864: Semiconductor Circuit Design		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Krautschneider	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0854: Mathematic	es IV				
Courses					
		T	Han fade	0.0	
Title	[Facebook] (1400)	Тур	Hrs/wk	CP	
Differential Equations 2 (Partial Differential		Lecture	2	1	
Differential Equations 2 (Partial Differential		Recitation Section (small)	1	1	
Differential Equations 2 (Partial Differential	Equations) (L1045)	Recitation Section (large)	1 2	1	
Complex Functions (L1038) Complex Functions (L1041)		Lecture	1	1	
		Recitation Section (small)	1	1	
Complex Functions (L1042)	<u></u>	Recitation Section (large)	ı	ı	
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	none				
Recommended Previous	Mathematics 1 - III				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results			
Professional Competence	7,				
Knowledge					
Knowieuge	Students can name the basic concepts in Mathema	tics IV. They are able to explain them using appro	priate examples.		
	Students can discuss logical connections between	these concepts. They are capable of illustrating t	hese connections w	ith the help of examples	
	They know proof strategies and can reproduce ther				
	, p				
Skills	Studente can model problems in Marks and in 194	ith the help of the concents of the distance	Morocyce #====	concelle of column 41	
	Students can model problems in Mathematics IV w	in the help of the concepts studied in this course	. woreover, they are	capable of solving thei	
	by applying established methods.				
	Students are able to discover and verify further logic	cal connections between the concepts studied in	the course.		
	<ul> <li>For a given problem, the students can develop and</li> </ul>	execute a suitable approach, and are able to crit	cally evaluate the re	esults.	
Paraenal Compotonos					
Personal Competence					
Social Competence	Students are able to work together in teams. They a	uro canablo to uso mathematics as a common lan	allago		
	In doing so, they can communicate new concepts		iers. Moreover, they	can design examples i	
	check and deepen the understanding of their peers	i.			
Autonomy					
,	<ul> <li>Students are capable of checking their understand</li> </ul>	ling of complex concepts on their own. They car	n specify open ques	tions precisely and know	
	where to get help in solving them.				
	Students have developed sufficient persistence to be	pe able to work for longer periods in a goal-orient	ed manner on hard	oroblems.	
	·		·		
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 Equation	ns 2)			
Assignment for the Following	General Engineering Science (German program): Speciali	sation Electrical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialis		nics: Compulsory		
Garrioula				eering: Compulsory	
	General Engineering Science (German program): Speciali		a wechanical Engin	eemig. Compulsory	
	General Engineering Science (German program): Speciali	• •			
	General Engineering Science (German program, 7 semest		•		
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineering, Focu	is Mechatronics: Co	mpulsory	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineering	
	Compulsory				
	General Engineering Science (German program, 7 semest	er); Specialisation Naval Architecture: Compulso	rv		
	Computer Science: Specialisation Computational Mathematical		•		
		alics. Elective Compulsory			
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialis	sation Electrical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program): Specialis			eering: Compulsorv	
	General Engineering Science (English program, 7 semeste	* *	-	3	
				nnulcon/	
	General Engineering Science (English program, 7 semeste				
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineering	
	Compulsory				
	General Engineering Science (English program, 7 semeste	er): Specialisation Naval Architecture: Compulsor	y		
	Computational Science and Engineering: Specialisation E	ngineering Sciences: Elective Compulsorv			
	Computational Science and Engineering: Specialisation C				
	, , , , , , , , , , , , , , , , , , , ,				
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Mechanical Engineering: Specialisation Theoretical Engineering: Specialisation Theoretical Engineering: Specialisation Theoretical Engineering: Specialisation Engineering: Specialisat				
	Mechanical Engineering: Specialisation Mechatronics: Con	mpulsory			
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Compleme	entary Course Care Studies: Flective Compulsors			



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 Equation	s 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	



## **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.

	g processes, to high-performance materials.  Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	СР
	JI (10364)		2	2
Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design		Lecture Recitation Section (large)	2	1
Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design			2	*
Advanced Mechanical Engineering Design I (L0262)  Advanced Mechanical Engineering Design I (L0263)  Lecture 2  Advanced Mechanical Engineering Design I (L0263)  Recitation Section (large) 2  1				
	Prof. Dieter Krause	ricolation decison (large)		
Module Responsible  Admission Requirements	None			
Recommended Previous	11010			
Knowledge	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
	Ţ Ţ			
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and functions of machine			
	<ul> <li>explain requirements, selection criteria, application scenario</li> </ul>	s and practical examples of complex r	nachine elements,	
	<ul> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	After passing the module, students are able to:			
S.i.iii	The passing at module, clausing are also to:			
	<ul> <li>accomplish dimensioning calculations of covered machine e</li> </ul>	lements,		
	<ul> <li>transfer knowledge learned in the module to new requirement</li> </ul>	nts and tasks (problem solving skills),		
	<ul> <li>recognize the content of technical drawings and schematic s</li> </ul>	ketches,		
	<ul> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	Students are able to discuss technical information in the least	ure supported by activating methods		
	<ul> <li>Students are able to discuss technical information in the lect</li> </ul>	are supported by activating methods.		
Autonomy				
	Students are able to independently deepen their acquired kr			
	<ul> <li>Students are able to acquire additional knowledge and to</li> </ul>	recapitulate poorly understood cont	ent e.g. by using the	video recordings of th
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
		about at England at England	2	
Assignment for the Following	General Engineering Science (German program): Specialisation Me			
Curricula	General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Material	s in Engineering Scien	ices: Compulsory
	General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Product	Development and Pro	duction: Compulsory
	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Theoreti	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compui			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineerin	g, Focus Materials in	Engineering Sciences
	Compulsory			
	General Engineering Science (German program, 7 semester): Spec	ialisation Mechanical Engineering, Fo	cus Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semester): Sp.	ecialisation Mechanical Engineering,	Focus Product Devel	opment and Production
	Compulsory			
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	. Focus Theoretical M	Mechanical Engineering
	Compulsory			
		ialisation Mechanical Engineering Fo	cus Biomechanics: Co	mpulsory
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				
				ompaisory
	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 Me			ces: Compulsory
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program): Specialisation Me	chanical Engineering, Focus Product I	Development and Proc	duction: Compulsory
		described Englished English English Theory	al Maskasiaal Easiaa	
	General Engineering Science (English program): Specialisation Me	cnanicai Engineering, Focus Theoretic	ai wechanicai Engine	ering: Compulsory
	General Engineering Science (English program): Specialisation Me General Engineering Science (English program, 7 semester): Speci		-	
		alisation Mechanical Engineering, Foo	cus Aircraft Systems Er	ngineering: Compulsory
	General Engineering Science (English program, 7 semester): Speci	alisation Mechanical Engineering, Foo	cus Aircraft Systems Er	ngineering: Compulsory
	General Engineering Science (English program, 7 semester): Speci General Engineering Science (English program, 7 semester): S	alisation Mechanical Engineering, Foo pecialisation Mechanical Engineerin	cus Aircraft Systems Er g, Focus Materials in	ngineering: Compulsory Engineering Sciences
	General Engineering Science (English program, 7 semester): Speci General Engineering Science (English program, 7 semester): S Compulsory	alisation Mechanical Engineering, Foo pecialisation Mechanical Engineerin alisation Mechanical Engineering, Foo	eus Aircraft Systems Er g, Focus Materials in eus Mechatronics: Com	ngineering: Compulsory Engineering Science: npulsory



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	
Content	Advanced mechanical Engineering Design ( & ii	
	Lecture	
	Fundamentals of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	• Seals	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	Crank drives	
	Sliding bearings     Elements of fluidics	
	Elements of indicts	
	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)	
	- Guedation of Hydrodate dystems (indicate)	
Literature	Dubbel, Taschenbuch für den Maschinenbau: Grote, KH., Feldhusen, J.(Hrsq.); Springer-Verlag, aktuelle Auflage.	
	<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> </ul>	
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.     Finführung in die DIN Normen: Klein, M. Touhner, Verlag.	
	<ul> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> </ul>	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.  Machinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      Det ("Antel Maschine advances Miller H. M. In D. Lengerth B. McGirl, H. O. ("Angel H. O. ("Ang	
	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		
Comoni	7.4.4.1.00.4.1.00.1.1.1.1.1.1.1.1.1.1.1.1		
	Lecture		
	Fundamentals of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Seals		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank drives		
	Sliding bearings		
	Elements of fluidics		
	Exercise		
	Lacture		
	Calculation methods of the following machine elements:		
	<ul> <li>Linear rolling bearings</li> </ul>		
	Axes & shafts		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank gears		
	Sliding bearings		
	Calculations of hydrostatic systems (fluidics)		
Literature	Dubbel Teachanhugh für den Macchinenhaus Orate V. H. Faldhugen, I. Ulter V. Creinner, Verlan, aldereite Aufferen		
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.      Maschinenble Bend Lilly Niemann C. Corinen Verlag, although Auflage.		
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.      Maschinene und Kenthultingscharpster Chickiller W. Pinger P. Springer Verlag, aktuelle Auflage.		
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.      The second of the DNN News and Mark the second of the secon		
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.      Koostruktionelebre Bahl, C. Reitz, W. Springer, Verlag, aktivalle Auflage.      Koostruktionelebre Bahl, C. Reitz, W. Springer, Verlag, aktivalle Auflage.		
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.  Masshipper langer 1. 0: Schlecht B. Barger Median ektyrelle Auflage.		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.      Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.		
	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



odule M0596: Advanced I	Mechanical Design Project
ourses	
tle	Typ Hrs/wk CP
vanced Mechanical Design Project (L02	76
	Prof. Dieter Krause
	None
Admission Requirements	Note
Recommended Previous  Knowledge	Mechanical Engineering: Design
Kilowiedge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part auggeografilis, at identa have received the fallowing learning receits
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence  Knowledge	After passing the module, students are able to:
Moweage	Alter passing the module, students are able to.
	express the procedure for systematically handling of
	complex design tasks ,
	<ul> <li>describe working principles, their use and combination possibilities,</li> </ul>
	explain guidelines for designing for function and manufacturing,
	explain advanced use-oriented knowledge of machine elements.
Skills	After passing the module, students are able to:
	analyze complex tasks and develop principle solutions using sketches,
	convert principle solutions into a detailed design,
	<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	
•	After passing the module, students are able to:
oodal oompetence	Alter 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
Autonomy	After passing the module, students are able to:
	, mar paramag and more and and an analysis
	<ul> <li>independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate method</li> </ul>
	to independently solve problems.
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: Compuls
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineer
	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): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsor
	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: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product
	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: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product 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: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product



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 M1009: Material Sc	ience I aboratory			
Module W1003. Material 30	ience Euboratory			
Courses				
Title		Тур	Hrs/wk	СР
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)		Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of	experiments in the area of materials scie	nces and illustrate respe	ctive relationships. They
	are capable of describing and communicating relevant proble	ems and questions using appropriate to	echnical language. They	can explain the typical
	process of solving practical problems and present related resul	ts.		
01.11				
Skills	The students can transfer their fundamental knowledge on ma		practical problems. The	y identify and overcome
	typical problems during the realization of experiments in the co	ntext of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to con-	duct experiments in the context of materi	als sciences. They are a	ble to effectively present
	and explain their results alone or in groups in front of a qualified	d audience.		
4.4	Ot death and a shift of addition with the second of the	to date of the control of the date of the control		and the second transfer
Autonomy	Students are capable of solving problems in the context of ma		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 Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory			
Curricula	General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Produ	ct Development and Prod	duction: Compulsory
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engineer	ring, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Specialisation		-	
	General Engineering Science (English program): Specialisation		·	
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	Compulsory			
	Mechanical Engineering: Specialisation Product Development			
	Mechanical Engineering: Specialisation Materials in Engineering			
	Product Development, Materials and Production: Technical Con	mplementary Course Core Studies: Elect	ive Compulsory	

0	for Model to Colonia Laboratory
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 M0726: Production	Technology			
Courses				
litle		Тур	Hrs/wk	СР
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			
	internally recommended			
	Previous knowledge in mathematics, mechanics and electr	ical engineering		
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to			
	<ul> <li>explain the basics of chip formation and mechanism</li> </ul>	is and models of machining.		
	explain methods and parameters for design and and		and tools.	
	explain technical concepts of machine tool building			
	<ul> <li>explain types, constructions and functions of CNC-n</li> </ul>			
	explain equipment components.	<u> </u>	•	
Skills	Students are able to			
Skills	Students are able to			
	<ul> <li>select tool geometry, cutting materials, process para</li> </ul>	meters and appropriate measuring technique	in accordance with the	e requirements.
	<ul> <li>estimate occurring forces and temperatures during of</li> </ul>	chip formation.		
	<ul> <li>select appropriate machine tools for machining and</li> </ul>	create NC programs for turning and milling.		
	<ul> <li>assess the quality of a machine tools and to detect v</li> </ul>	veak points.		
Personal Competence				
	Students are able to			
	<ul> <li>develop solutions in a production environment with</li> </ul>	qualified personnel at technical level and rep	resent decisions	
	a composition a production of manners	quamiou porocimo, artocimicar iovor and rop		
Autonomy	Students are able to			
	<ul> <li>interpret independently cutting processes.</li> </ul>			
	<ul> <li>create independently NC programs.</li> </ul>			
	select independently machine tools by reference to	appropriate requirements.		
	assess own strengths and weaknesses in general.			
	<ul> <li>assess their learning progress and define gaps to be</li> </ul>	e 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): Specialis	ation Mechanical Engineering, Focus Produc	t Development and Pro	duction: Compulsory
Curricula	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engineering	g, Focus Product Deve	lopment and Product
	Compulsory			
	General Engineering Science (English program): Specialis	ation Mechanical Engineering, Focus Produc	Development and Pro	duction: Compulsory
	General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical Engineering	, Focus Product Deve	lopment and Product
	Compulsory			
	Mechanical Engineering: Specialisation Product Developm	ent and Production: Compulsory		



Course L0689: Fundamentals of Machine Tools		
	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	
	Donni (d.a.). Opringor, 2000	



Course L0613: Forming and Cutting	Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	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 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 M0599: Integrated I	Product Development and Lightweight Desi	gn		
Courses				
Title		Тур	Hrs/wk	СР
CAE-Team Project (L0271)		Problem-based Learning	2	2
Development of Lightweight Design Produc	cts (L0270)	Lecture	2	2
ntegrated 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 fol	lowing learning results		
Professional Competence  Knowledge	After completing the module, students are capable of:			
	a complete in the forest and evication of OD CAD Conta	TO DOM and FEM Customs		
	<ul> <li>explaining the functional principle of 3D-CAD-Syster</li> <li>describing the interaction of the different CAE-Syster</li> </ul>	•		
	describing the interaction of the different CAL-System	ns in the product development process		
Skills				
	After completing the module, students are able to:			
	,			
	<ul> <li>evaluate different CAD- and PDM-Systems with rega</li> </ul>	ards to the desired requirements such as classifi	cation schemes and	product structuring
	<ul> <li>design an exemplary product using CAD-,PDM- and</li> </ul>	or FEM-Systems with shared workload		
B				
Personal Competence Social Competence	After completing the module, students are able to:			
Social Competence	After completing the module, students are able to.			
	To develop a project plan and allocate work appropriate and allocate allocate and	riate work packages in the framework of group of	discussions	
	Present project results as a team for instance in a pro-	esentation		
Autonomy	Students are capable of:			
,	·	all and a second and the about 1916 to		
	<ul> <li>independently adapt to a CAE-Tool and complete a</li> </ul>	given 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): Specialis			
Curricula	General Engineering Science (German program): Specialis			
	General Engineering Science (German program, 7 semeste		•	
	General Engineering Science (German program, 7 semes Compulsory	sier). Specialisation Mechanical Engineering, F	-ocus Product Devel	opinent and Production
	General Engineering Science (English program): Specialisa	ation Mechanical Engineering, Focus Aircraft Sv	stems Engineering: (	Compulsory
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semeste	• •	•	
	General Engineering Science (English program, 7 semes			
	Compulsory	3,		
	Mechanical Engineering: Specialisation Product Developm	ent and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems Er	ngineering: Compulsory		
	Product Development, Materials and Production: Technical	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	tweight 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 Design		Lecture	2	2
Advanced Mechanical Engineering Desigr Advanced Mechanical Engineering Desigr		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			
v	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
·				
	explain complex working principles and functions			
	explain requirements, selection criteria, application		chine elements,	
	<ul> <li>indicate the background of dimensioning calculat</li> </ul>	ions.		
Skills	After passing the module, students are able to:			
	The state of the s	and the standards		
	accomplish dimensioning calculations of covered     transfer knowledge learned in the module to new			
	<ul> <li>transfer knowledge learned in the module to new</li> <li>recognize the content of technical drawings and s</li> </ul>			
	evaluate complex designs, technically.	chematic sketches,		
	- evaluate complex accigns, termically.			
Personal Competence				
Social Competence	Students are able to discuss technical information	in the lecture supported by activating methods		
	olddenis are able to discuss technical information	The recture supported by activating methods.		
Autonomy	Chudanta are able to independently deepen their	agguired knowledge in evereing		
	Students are able to independently deepen their     Students are able to acquire additional knowle		nt e.a. by using the	video recordings of
	lectures.	age and to recapitulate poorly understood conte	it e.g. by using the	video recordings or
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit nainte	6			
Credit points	ů .			
Examination	Written exam			
Examination	Written exam	lisation Mechanical Engineering, Focus Energy Sy	rstems: Compulsory	
Examination Examination duration and scale	Written exam 120 General Engineering Science (German program): Special General Engineering Science (German program): Special	lisation Mechanical Engineering, Focus Aircraft Sy	stems Engineering: (	
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia General Engineering Science (German program): Specia General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Aircraft Sy Ilisation Mechanical Engineering, Focus Materials	stems Engineering: 0 in Engineering Scien	
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Aircraft Sy lisation Mechanical Engineering, Focus Materials lisation Mechanical Engineering, Focus Mechatror	stems Engineering: 0 in Engineering Scien nics: Compulsory	ces: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Aircraft Sy lisation Mechanical Engineering, Focus Materials lisation Mechanical Engineering, Focus Mechatror lisation Mechanical Engineering, Focus Product D	stems Engineering: On In Engineering Scien nics: Compulsory evelopment and Prod	ces: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Aircraft Sy lisation Mechanical Engineering, Focus Materials lisation Mechanical Engineering, Focus Mechatror lisation Mechanical Engineering, Focus Product D lisation Mechanical Engineering, Focus Theoretica	stems Engineering: ( in Engineering Scien nics: Compulsory evelopment and Prod al Mechanical Engine	ces: Compulsory duction: Compulsory pering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia General Engineering Science (German program, 7 semes	lisation Mechanical Engineering, Focus Aircraft Sy lisation Mechanical Engineering, Focus Materials lisation Mechanical Engineering, Focus Mechatror lisation Mechanical Engineering, Focus Product D lisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus	stems Engineering: On Engineering Scien ics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems En	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Specia General Engineering Science (German program, 7 seme General Engineering Science (German program)	lisation Mechanical Engineering, Focus Aircraft Sy lisation Mechanical Engineering, Focus Materials lisation Mechanical Engineering, Focus Mechatror lisation Mechanical Engineering, Focus Product D lisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus	stems Engineering: On Engineering Scien ics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems En	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulso
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 semental Engineering Science (German program)	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretical ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering,	stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine is Aircraft Systems Er Focus Materials in	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsi Engineering Science
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Focus Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Focus Mechanical Engineering, Focus Mechanical Engi	stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine is Aircraft Systems Er Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsi Engineering Science
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 semental Engineering Science (German program)	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Focus Mechanical Engineering, Focus Specialisation Mechanical Engineering, Focus Focus Mechanical Engineering, Focus Mechanical Engi	stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine is Aircraft Systems Er Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsi Engineering Science
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus ester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus	stems Engineering: (in Engineering Scien Engineering Scien nics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems En Focus Materials in its Mechatronics: Confocus Product Development	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus ester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus	stems Engineering: (in Engineering Scien Engineering Scien nics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems En Focus Materials in its Mechatronics: Confocus Product Development	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus disation Mechanical Engineering,	stems Engineering: (in Engineering Scien Engineering Scien in Engineering Scien in Engineering Scien in Engineering Mechanical Engineering Aircraft Systems Enfocus Materials in Instrument in Instrument Instrum	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus	stems Engineering: (in Engineering Scien Engineering Scien incs: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems En Focus Materials in incs Mechatronics: Confocus Product Development and Theoretical Mes Biomechanics: Confocus Biomechanics: Confocus Biomechanics: Confocus Biomechanics: Confocus Biomechanics: Confocus Biomechanics: Confocus Product Confocus	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Compulsory	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus eter): Specialisation Mechanical Engineering, Focus eter): Specialisation Mechanical Engineering, Focus eter): Specialisation Mechanical Engineering, Focus eter): Specialisation Mechanical Engineering, Focus	stems Engineering: Con Engineering: Con Engineering Scien ics: Compulsory evelopment and Procal Mechanical Engine is Aircraft Systems En Focus Materials in its Mechatronics: Confocus Product Development and Theoretical Mechatronics: Confocus Theoretical Mechatronics: Confocus Energy Systems: Constant Energy Systems: Con	ces: Compulsory duction: Compulsory pering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory  General Engineering Science (German program, 7 seme Compulsory  General Engineering Science (German program, 7 seme General Engineering Science (German program)	disation Mechanical Engineering, Focus Aircraft Sy disation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product D disation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus enseter): Specialisation Mechanical Engineering, Focus eter): Specialisation Mechanical Engineering, Focus Energy Sy	stems Engineering: Con Engineering: Con Engineering Scien ics: Compulsory evelopment and Procal Mechanical Engine is Aircraft Systems Enfocus Materials in ics Mechatronics: Confocus Product Development and Engineering Theoretical Mechatronics: Confocus Theoretical Mechanics: Confocus Energy Systems: Costems: Compulsory	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory  General Engineering Science (German program, 7 seme Compulsory  General Engineering Science (German program, 7 seme General Engineering Science (German program): Special Engineering Science (German program): Special Engineering Science (English program): Special	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretica ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus	stems Engineering: Con Engineering: Con Engineering Scientics: Compulsory evelopment and Product Mechanical Engine is Aircraft Systems Engine is Mechatronics: Confocus Product Development and Product Development is Biomechanics: Confocus Theoretical Mechanics: Confocus Energy Systems: Costems: Compulsory stems Engineering: Confocus Engineering: Confocus Engineering: Costems Engineering: Confocus Engineering: Confoc	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme General Engineering Science (German program): Special General Engineering Science (English program): Special General Engineering Science (English program): Special General Engineering Science (English program): Special	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatror disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus Theoretics Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials i disation Mechanical Engineering, Focus Materials i	stems Engineering: Con Engineering: Con Engineering Scient in Engineering: Con Engineering Science	ces: Compulsory duction: Compulsory eering: Compulsory ngineering: Compulsor Engineering Science npulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme General Engineering Science (English program): Special General Engineering Scienc	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus Theoretics Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials i disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product December 1962 (1992)	stems Engineering: Con Engineering Scient Engineering Scient In Engineering: Con Engineering: Con Engineering Scient In Engineering In	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compulsory ngineering: Compulsory opment and Product Mechanical Engineer mpulsory compulsory compulsory des: Compulsory duction: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (English program): Special General Enginee	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials i disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Decision Mechanical Engineering, Focus Theoretical Station Mechanical Engineering,	stems Engineering: Con Engineering Scientics: Compulsory evelopment and Product Mechanical Engine is Aircraft Systems Enfocus Materials in Cocus Product Development and Product Development Engineering: Con Engineering: Con Engineering: Con Engineering Sciencics: Compulsory evelopment and Product Engineering In Engineeri	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (English program): Special General Enginee	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Materials in disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Decision Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Theoretic	stems Engineering: Con Engineering Scientics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems Engineering: Con Engineering Sciencics: Compulsory evelopment and Prodal Mechanical Engineers Aircraft Systems En	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme General Engineering Science (English program): Special General Engineering Scienc	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Materials in disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Decision Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Theoretic	stems Engineering: Con Engineering Scientics: Compulsory evelopment and Prodal Mechanical Engine is Aircraft Systems Engineering: Con Engineering Sciencics: Compulsory evelopment and Prodal Mechanical Engineers Aircraft Systems En	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program): Special General Engineering Science (English program): Special General Engin	disation Mechanical Engineering, Focus Aircraft Sydisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretics ster): Specialisation Mechanical Engineering, Focus Energy Sydisation Mechanical Engineering, Focus Materials in disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Decision Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Mester): Specialisation Mechanical Engineering, Focus	stems Engineering: Con Engineering Scient Engineering Scient and Proceedings Aircraft Systems Engineering: Con Engineering Science ics: Compulsory evelopment and Proceeding Mechanical Engineering Aircraft Systems Engineering: Con Engineering Science is Aircraft Systems Engineering: Con Engineering Science in Engineering Science in Engineering Science in Engineering Enginee	ces: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory regineering: Compulsory dering: Compulsory dering: Compulsory dechanical Engineer dechanica
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme General Engineering Science (English program): Special Compulsory General Engineering Science (English program): Special Compulsory General Engineering Science (English program): Special Engi	disation Mechanical Engineering, Focus Aircraft Sycilisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Energy Sycilisation Mechanical Engineering, Focus Materials in distribution Mechanical Engineering, Focus Mechatron distribution Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Me	stems Engineering: Con Engineering: Compulsory evelopment and Prod al Mechanical Engine as Aircraft Systems En Focus Materials in as Mechatronics: Con focus Product Develo as Biomechanics: Con as Energy Systems: Co stems: Compulsory stems Engineering: Con ics: Compulsory evelopment and Prod al Mechanical Engine s Aircraft Systems En Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory regineering: Compulsory
Examination Examination duration and scale Assignment for the Following	Written exam  120  General Engineering Science (German program): Special General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program): Special General Engineering Science (English program): Special General Engin	disation Mechanical Engineering, Focus Aircraft Sycilisation Mechanical Engineering, Focus Materials disation Mechanical Engineering, Focus Mechatron disation Mechanical Engineering, Focus Product Dulisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Energy Sycilisation Mechanical Engineering, Focus Materials in distribution Mechanical Engineering, Focus Mechatron distribution Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus Theoretica Ster): Specialisation Mechanical Engineering, Focus mester): Specialisation Me	stems Engineering: Con Engineering: Compulsory evelopment and Prod al Mechanical Engine as Aircraft Systems En Focus Materials in as Mechatronics: Con focus Product Develo as Biomechanics: Con as Energy Systems: Co stems: Compulsory stems Engineering: Con ics: Compulsory evelopment and Prod al Mechanical Engine s Aircraft Systems En Focus Materials in	ces: Compulsory duction: Compulsory pering: Compulsory regineering: 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 Mechanica	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
Content	Advanced mechanical Engineering Design Ltd.
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes     Path 9 above divisors
	Belt & chain drives
	• Gear drives
	Epicyclic gears
	• Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	<ul> <li>Linear rolling bearings</li> </ul>
	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
Content	Advanced Mechanical Engineering Design I & II
Content	Actuated medianneal Engineering Ecognitics
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings     Elements of fluidics
	Elements of inducts
	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.
	<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.
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	Sowie weitere Bücher zu speziellen Themen

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



courses				
itle	Typ Hrs/wk CP			
dvanced 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,			
	explain guidelines for designing for function and manufacturing,			
	explain advanced use-oriented knowledge of machine elements.			
Chille	After a series the module shadows are able to			
SKIIIS	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.			
Personal Competence				
	After passing the module, students are able to:			
coolai compotento	This passing the media, diddenic are also to			
	present and discuss solutions and technical drawings within groups,			
	reflect the own results in the work groups of the course			
Autonomy	After passing the module, students are able to:			
,				
	<ul> <li>independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate method</li> </ul>			
	to independently solve problems.			
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: Compulso			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Producti			
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineeri			
	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: Compulso			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product			
	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.
	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 M0684: Heat Transf	fer			
Courses				
Title		Тур	Hrs/wk	CP
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)		Recitation Section (large)	2	1
Module Responsible	Dr. Andreas Moschallski		<del>_</del>	
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rning 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 app	roach		
coda compositio	The state his are also to allocate in small groupe and develop an app.			
Autonomy	The students are able to develop a complex problem self-consistent a	and analyse the results in a critical w	ay. 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 Mec	hanical Engineering, Focus Biomech	anics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Mec			
	General Engineering Science (German program): Specialisation Bion		, ,	
	General Engineering Science (German program): Specialisation Mec	hanical Engineering, Focus Theoreti	cal Mechanical Engine	ering: Compulsory
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineering, Fo	cus Energy Systems: C	ompulsory
	General Engineering Science (German program, 7 semester): Spe			
	Compulsory			
	General Engineering Science (German program, 7 semester): Specia	lisation Biomedical Engineering: Co	mpulsory	
	General Engineering Science (English program): Specialisation Biom		•	
	General Engineering Science (English program): Specialisation Mech		anics: Compulsory	
	General Engineering Science (English program): Specialisation Mech			
	General Engineering Science (English program): Specialisation Mech			ering: Compulsory
	General Engineering Science (English program, 7 semester): Special	isation Mechanical Engineering, Foo	us Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering	, Focus Theoretical M	lechanical Engineering:
	Compulsory			
	General Engineering Science (English program, 7 semester): Special	isation Biomedical Engineering: Cor	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulsor	у		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engi	neering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, 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	1	
Workload in Hours	Independent Study Time 2, 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			
Module W1320: Simulation	and Design of Mechatronic Systems			
Courses				
Title		Тур	Hrs/wk	СР
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2	2
Simulation and Design of Mechatronic Sys	tems (L1824)	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 e	engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for	design, modeling, simulation and optimization	of mechatronic system	ns.
Skills	Students are able to apply modern algorithms for mode	ling of mechatronic systems. They can identi	fy, 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 grou	ups and present results to target groups.		
,	Seasons are able to not goal one not on an inner mixed groups and proport recents to target groups.			
Autonomy	Students are able to recognize and improve knowledge deficits independently.			
	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		· · · · · · · · · · · · · · · · · · ·	
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialis	ation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
Curricula	General Engineering Science (German program): Specialis			Compulsory
	General Engineering Science (German program): Specialis	ation Mechanical Engineering, Focus Theoretic	cal Mechanical Engin	eering: Compulsory
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engineering, Foo	cus Mechatronics: Coi	mpulsory
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compulsory
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical Engineering	, Focus Theoretical I	Mechanical Engineering
	Elective Compulsory			
	General Engineering Science (English program): Specialis	ation Mechanical Engineering, Focus Aircraft S	ystems Engineering: 0	Compulsory
	General Engineering Science (English program): Specialis	ation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory			
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical Engineering, Foc	us Mechatronics: Con	npulsory
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical Engineering, Foc	us Aircraft Systems Ei	ngineering: Compulsory
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engineering	Focus Theoretical I	Mechanical Engineering
	Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems En			
	Mechanical Engineering: Specialisation Mechatronics: Con			
	Mechanical Engineering: Specialisation Theoretical Mechanical	nical Engineering: Compulsory		
	Mechatronics: Core qualification: Compulsory			

Course L1822: Simulation and Design of Mechatronic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	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	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 M0854: Mathematic	es IV				
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			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	Watermates 1 m				
	A6 - tall tall tall	. fellow to a local to a	11-		
Educational Objectives	After taking part successfully, students have reached the	e following learning i	esuits		
Professional Competence					
Knowledge	Students can name the basic concepts in Mather	matics IV. Thou are a	able to explain them using appr	ropriato ovamplos	
	·				4h 4h a h a la af aa.a.l
	Students can discuss logical connections between		rriey are capable of illustrating	litese confiections wi	ui tile lielp of example
	They know proof strategies and can reproduce the strategies.	nem.			
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 th
	by applying established methods.				
	<ul> <li>Students are able to discover and verify further lo</li> </ul>	ogical connections b	etween the concepts studied in	n the course.	
	<ul> <li>For a given problem, the students can develop a</li> </ul>	and execute a suitabl	e approach, and are able to cri	itically evaluate the re	sults.
Personal Competence					
•					
Social Competence	Students are able to work together in teams. The	v are canable to use	mathematics as a common la	nauaae	
					oon dooign overmale
	In doing so, they can communicate new concep		needs of their cooperating par	thers. Moreover, they	can design example
	check and deepen the understanding of their per	ers.			
Autonomy					
	<ul> <li>Students are capable of checking their understa</li> </ul>	anding of complex c	oncepts on their own. They ca	an specify open quest	tions precisely and kr
	where to get help in solving them.				
	<ul> <li>Students have developed sufficient persistence t</li> </ul>	to be able to work for	r longer periods in a goal-orien	ited manner on hard p	oroblems.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points					
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	ialisation Electrical E	Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speci	ialisation Mechanica	I Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (German program): Speci	ialisation Mechanica	I Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program): Speci		-	3	. ,
	General Engineering Science (German program, 7 semi		, ,	nulsory	
				•	mouleon
	General Engineering Science (German program, 7 seme				
	General Engineering Science (German program, 7 se	emester): Specialisa	mon wechanical Engineering.	, rocus ineoretical N	wechanical Engineer
	Compulsory				
	General Engineering Science (German program, 7 semi		•	ory	
	Computer Science: Specialisation Computational Mathe	ematics: Elective Cor	mpulsory		
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specia	alisation Electrical E	ngineering: Compulsory		
	General Engineering Science (English program): Specia				
	General Engineering Science (English program): Specia			nics: Compulsorv	
	General Engineering Science (English program): Specia				ering: Compulsory
				_	.ciig. Compulsory
	General Engineering Science (English program, 7 seme				
	General Engineering Science (English program, 7 seme		-		
	General Engineering Science (English program, 7 se	emester): Specialisa	tion Mechanical Engineering,	Focus Theoretical N	Mechanical Engineer
	Compulsory				
	General Engineering Science (English program, 7 seme	ester): Specialisation	Naval Architecture: Compulso	ory	
	Computational Science and Engineering: Specialisation		·		
	Computational Science and Engineering: Specialisation	-			
		·			
	Mechanical Engineering: Specialisation Theoretical Med	-	y. Compuisory		
	Mechanical Engineering: Specialisation Mechatronics: 0	Compulsory			
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Comple	ementary Course Co	re Studies: Elective Compulsor	v	



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations	
Literature	<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	
	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: Fundamen	tals of Process Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Introduction into Process Engineering/Biop		Lecture	2	1
Fundamentals of material engineering (L0)	830)	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:			
	give an evention of the most important fields on pro	ooss and highrooss anginogring		
	<ul> <li>give an overview of the most important fields on pro</li> <li>explain some working methods for different fields in</li> </ul>			
	explain some working methods for different fields in	process engineering.		
Skills	After passing this module the students should have the abil	ity to:		
	list and outline the most important fields of process of the second			
	name the most important working approaches or me	etnods of the different fields of process en	gineering,	
	read and prepare an engineering drawing,			
	explain the most important technologies for wasteway			
	scheme typical chemical and biotechnological procedure.	esses independently with the aid of point	ers.	
Personal Competence				
Social Competence	The students are able to			
	- and an income to the form of the control of the c			
	work out results in groups and document them,	and the six according to the s		
	provide appropriate feedback and handle feedback	on their own performance constructively.		
Autonomy	The students are able to estimate their progress of learn	ning by themselves and to deliberate th	eir lack of knowledge in Pr	ocess Engineering and
	Bioprocess Engineering.			
Westers are to	Independent Chally Time 04 Ot at Time in Land 25			
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	Written exam			
Examination				
Examination duration and scale	90 min	office Business Facility 1		
Assignment for the Following	General Engineering Science (German program): Specialis			
Curricula	General Engineering Science (German program): Specialis		•	
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste	er): Specialisation Bioprocess Engineerin	g: Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis		ry	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	r): Specialisation Bioprocess Engineering	g: Compulsory	
	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	terial 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 Ch	nemistry			
Courses				
Title		Тур	Hrs/wk	CP
Physical Chemistry (L0833) Physical Chemistry (L0835)		Lecture  Laboratory Course	2	2
	Prof. Hans-Ulrich Moritz	Laboratory Course	2	
Module Responsible	None			
Admission Requirements Recommended Previous	Contents of the previous modules inorganic chemistry, physics for e	naineers and mathematics I III		
Knowledge	Contents of the previous modules morganic chemistry, physics for e	ngmeers and mathematics i-iii.		
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence	The taking part societies, state that the total are telesting.	Janning Toodilo		
Knowledge	The students are able,			
3 - 13				
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-, hear	- and momentum transfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.			
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and kind	etic calculations.		
	- assess new applications with respect to environmental sustainable	lity.		
	- abstract their knowldege to related issues to conduct thermodynar	nical, electrochemical and kinetic cald	culations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document expe	riments according to scientific guidel	ines in small groups.	
	The students are able to reflect their subject-specific knowledge ora	lly in a team and to discuss it with fell	ow students and faculty.	
Autonomy	Students are able to assess their knowldege continuously on their	own by exemplified practice. Student	s 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 Pr	ocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bi	oprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	ialisation Bioprocess Engineering: E	ective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation Pro			
	General Engineering Science (English program): Specialisation Bio		In a m	
	General Engineering Science (English program, 7 semester): Spec		•	
	General Engineering Science (English program, 7 semester): Spec Process Engineering: Core qualification: Compulsory	alisation Bioprocess Engineering: Eli	ecuve Compulsory	
	Frocess Engineering. Core quantication: 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
Cycle	WiSe
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
	Reaction kinetics
	Freezing-point depression (cryoscopy)
	Electrical mobility of ions
	Viscosimetry
	Heat of neutralization
	Surface tension
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Module M0536: Fundament	als of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
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	Mathematics I+II+III			
Knowledge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	<ul> <li>Simplification and solving of partial differential equation</li> </ul>	ons		
	<ul> <li>Integration</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	,			
Knowledge	Students are able to:			
	avalain the difference between different times of farms			
	<ul> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reyn</li> </ul>	olds Transport-Theorem in process engineeri	na	
	explain simplifications of the Continuity- and Navier-S			
···		, , , , , , ,		
Skills	The students are able to			
	<ul> <li>describe and model incompressible flows mathematic</li> </ul>	ally		
	<ul> <li>reduce the governing equations of fluid mechanics by</li> </ul>	·	ns e.g. by integration	
	notice the dependency between theory and technical			
	<ul> <li>use the learned basics for fluid dynamical applications</li> </ul>	s in fields of process engineering		
Personal Competence				
Social Competence	The students			
	<ul> <li>are capable to gather information from subject related</li> </ul>	, professional publications and relate that info	rmation to the contex	t of the lecture and
	able to work together on subject related tasks in small			
	exercises)			
	are able to work out solutions for exercises by themse	lves, 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 search to the search t			
	work on their exercises by their own and to evaluate the	neir 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): Specialisat			
Curricula	General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat		ompulson	
	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: C			
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program): Specialisati		ompulsory	
	General Engineering Science (English program): Specialisati General Engineering Science (English program, 7 semester):		leory	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			<i>y</i>
	Technomathematics: Specialisation III. Engineering Science:		- ,	
	Process Engineering: Core qualification: Compulsory			



Course L0091: Fundamentals of Flui	id Mechanics
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	<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>

ourse L0092: Fluid Mechanics for	Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	<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	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, Thermodynamics I a	and II		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge				
		s, the students learn the mathematical tools to des		
		by the mixing of compounds and learn concepts to		
		bria can be described mathematically and which p		f different phases (vapor
		e the fundamentals of reaction equilibria are taugh		
		s relevant for different kinds of processes are show	in and the necessary ki	nowledge for plotting and
	interpreting the equilibria are taught.			
Skills	Applying their knowledge, the students are at	ole to identify the correct equation for the determine	nation of the equilibriur	n state and know how t
	simplify these equations meaningfully.	, , ,	·	
		d to determine the properties of the system in the	equilibrium state and the	hey are able to solve the
	resulting mathematical relations.	, ,	•	•
		eliantly find necessary physico-chemical propertie	s of compounds as wel	I as model parameters in
	literature sources.			
	Beside pure compound properties the students	are capable of describing the properties of mixture	es.	
	The students know how to visualize phase equ	ilibria graphically and they know how to interpret th	ne occurring phenomen	a.
	Based on their knowledge, the students are	able to understand fundamental concepts that a	re the basis for many	separation and reaction
	processes in chemical engineering.			
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				
		ation self-reliantly in literature sources and to judge		
		heck their learning progress continuously in exerc	ises. Based on this kno	wledge the students car
	adept their learning process.			
Weekleed in Herme	Independent Chiele Time 104 Chiele Time in Leature 5	^		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	υ 		
Credit points				
Examination Examination duration and scale	Written exam			
	120 minutes; theoretical questions and calculations	cialization Process Facility of the Community		
Assignment for the Following Curricula	General Engineering Science (German program): Spe General Engineering Science (German program): Spe			
Curricula			nulcon	
	General Engineering Science (German program, 7 sei			
	General Engineering Science (German program, 7 sei	, ,	ompuisory	
	Bioprocess Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Spec			
	General Engineering Science (English program): Spec		vulaan.	
	General Engineering Science (English program, 7 sen		•	
	General Engineering Science (English program, 7 sen	nester): Specialisation Bioprocess Engineering: Co	mpulsory	
	Process Engineering: Core qualification: Compulsory			



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	
tle	Tvp 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
•	Mathematics 1-3
Recommended Previous  Knowledge	mainematics 1-3
Knowleage	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 expe
	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 si
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain whic
	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 as
	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 le
, alenemy	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
	$General\ Engineering\ Science\ (German\ program, 7\ semester):\ Specialisation\ Mechanical\ Engineering, Focus\ Aircraft\ Systems\ Engineering:\ Computer Systems\ Engineering:\ Computer\ Engineeri$
	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: Comput
	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
	Occasil Federalis Office (Fedial Association Association Mathedial Federalis
	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 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 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
ļ	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 M0891: Informatics	for Process Engineers			
Courses				
		T	How toda	0.0
Title		Тур	Hrs/wk 2	CP
Informatics for Process Engineers (L0836 Informatics for Process Engineers (L0837		Lecture Recitation Section (small)	2	2
Numeric and Matlab (L0125)	)	Laboratory Course	2	2
Module Responsible	Dr. Marcus Venzke	Education y Cource		
Admission Requirements	None.			
Recommended Previous	Basic knowledge in using MS Windows.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence	,,,	<u> </u>		
·	Students can describe procedural and object-oriented concepts.			
Skills	Students are capable of object-oriented programming in the programing language Java and of solving mathematic questions by using Matlab.  Students are capable of developing concepts (simple algorithms) to solve technical questions.			
Personal Competence Social Competence	Students are able to work out solutions together in small groups.			
Autonomy	-			
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 Proc	cess Engineering: Elective Compuls	ory	
Curricula	General Engineering Science (German program, 7 semester): Specia	llisation Energy and Enviromental E	ngineering: Elective Co	ompulsory
	General Engineering Science (German program, 7 semester): Specia	llisation Process Engineering: Electi	ve Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsi	ory		
	General Engineering Science (English program): Specialisation Proc	ess Engineering: Elective Compulso	ory	
	General Engineering Science (English program, 7 semester): Special	lisation Energy and Enviromental Er	ngineering: Elective Co	mpulsory
	General Engineering Science (English program, 7 semester): Special	lisation Process Engineering: Electiv	ve Compulsory	
	Process Engineering: Core qualification: Compulsory			



Course L0836: Informatics for Process 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	
	<ul> <li>Objects, classes</li> <li>Methods, properties</li> <li>Inheritance</li> <li>Basics of the language Java</li> <li>Sample application: Simulation of an electricity network</li> <li>2D graphics</li> <li>Events and Controls</li> </ul>	
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998.  Bibliothek: TII 978  Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002.  http://www.javabuch.de/  Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999.  Bibliothek: TII 717  Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999.  Bibliothek: TII 942  Java SE 7 Documentation  http://docs.oracle.com/javase/7/docs/  Java Platform, Standard Edition 7 API Specification  http://docs.oracle.com/javase/7/docs/api/	

Course L0837: Informatics for Process Engineers		
Тур	Recitation Section (small)	
Hrs/wk	2	
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



Courses				
Title		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (	L0841)	Lecture	2	3
Bioprocess Engineering- Fundamentals (L	_0842)	Recitation Section (large)	2	1
Bioprocess Engineering - Fundamental Pr	actical Course (L0843)	Laboratory Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	none			
Recommended Previous	none, module "organic chemistry", module "fundan	nentals for process engineering"		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	ed the following learning results		
<b>Professional Competence</b>				
Knowledge	Students are able to describe the basic concept	ts of bioprocess engineering. They are able to classif	y different types of I	kinetics for enzymes
	microorganisms, as well as to differentiate differen	nt types of inhibition. The parameters of stoichiometry ar	nd rheology can be n	amed and mass trans
	processes in bioreactors can be explained. The	students are capable to explain fundamental bioproce	ess management, ste	rilization technology
	downstream processing in detail.			
Skills	After successful completion of this module, studen	ts should be able to		
Skills	After successful completion of this module, student	is should be able to		
	describe different kinetic approaches for gr	owth and substrate-uptake and to calculate the correspo	onding parameters	
	predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process			
	analyze bioprocesses on basis of stoichion	netry and to set up / solve metabolic flux equations		
	distinguish between scale-up criteria for differential for differenti	fferent bioreactors and bioprocesses (anaerobic, aerobi	c as well as microaer	obic) to compare the
	well as to apply them to current biotechnical problem			
	propose solutions to complicated biotechno	ological problems and to deduce the corresponding mod	dels	
	to explore new knowledge resources and to			
	identify scientific problems with concrete including the second sec			
	to document and discuss their procedures a	as well as results in a scientilic manner		
B 1 O				
Personal Competence				
Social Competence		d be able to debate technical questions in small teams	to enhance the abili	ty to take position to
	own opinions and increase their capacity for team	work in engineering and scientific environments.		
Autonomy	After completion of this module participants will	be able to solve a technical problem in a team indep	endently by organizi	ng their workflow an
ŕ	present their results in a plenum.	·	, , ,	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	984		
Credit points	6			
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):	Specialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7	semester): Specialisation Process Engineering: Compu	ulsory	
	General Engineering Science (German program, 7	semester): Specialisation Bioprocess Engineering: Cor	mpulsory	
	Bioprocess Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): 5	Specialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): S			
		semester): Specialisation Process Engineering: Compu	Isory	
		semester): Specialisation Bioprocess Engineering: Con	•	
	Biomedical Engineering: Specialisation Artificial O	, ,		
	Biomedical Engineering: Specialisation Implants a			
		for a contract of the second s		
	Biomedical Engineering: Specialisation Medical To	echnology and Control Theory: Elective Compulsory		
		echnology and Control Theory: Elective Compulsory		
		ent and Business Administration: Elective 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	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng	
Language	DE	
Cycle	SoSe	
Content	1. Introduction (Prof. Liese, Prof. Zeng)	
	2. Enzymatic kinetics (Prof. Liese)	
	3. Stoichiometry I + II (Prof. Liese)	
	4. Microbial Kinetics I+II (Prof. Zeng)	
	5. Rheology (Prof. Liese)	
	6. Mass transfer in bioprocess (Prof. Zeng)	
	7. Continuous culture (Chemostat) (Prof. Zeng)	
	8. Sterilisation (Prof. Zeng)	
	9. Downstream processing (Prof. Liese)	
	10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)	
Literature	siehe Vorlesung	

Course L0843: Bioprocess 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 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				
<b>Educational Objectives</b>	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	With the completion of this module the students acquire in-dep	th knowledge of important cause-effect	chains of potential enviro	nmental problems whic
	might occur from production processes, projects or constructio	n measures. They have knowledge abo	ut the methodological div	ersity and are competer
	in dealing with different methods and instruments to assess e	environmental impacts. Besides the stud	lents are able to estimate	the complexity of thes
	environmental processes as well as uncertainties and difficulties	es with their measurement.		
Skills	The students are able to select a suitable method for the resp	pective case from the variety of assessr	nent methods. Thereby th	ey can develop suitable
	solutions for managing and mitigating environmental proble	ems in a business context. They are a	ble to carry out Life Cy	cle Impact Assessment
	independently and can apply the software programs OpenLCA		ning the course the studer	nts have the competenc
	to critically judge research results or other publications on envi	ronmental impacts.		
Personal Competence				
Social Competence	The students are able to discuss the various technical and so	cientific tasks, both subject-specific and	multidisciplinary. They ar	e able to develop joint
•	different solutions and to discuss their theoretical or practical			
	multi-layered issues of the environment protection and the c	oncept of sustainability. Their sensitivit	y and consciousness tow	ards these subjects ar
	raised and which helps to raise their awareness of their future	social responsibilities in their role as eng	jineers.	
Autonomy	The students learn to research, process and present a scient	ific topic independently. They are able	o carry out independent	scientific work. They ca
	solve an environmental problem in a business context and are	able to judge results of other publication	is.	
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			
Curricula	General Engineering Science (German program): Specialisation		•	
	General Engineering Science (German program, 7 semester):			у
	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semester):		Elective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsor	•		
	Energy and Environmental Engineering: Core qualification: Co		0	
	General Engineering Science (English program): Specialisatio	• •		
	General Engineering Science (English program): Specialisatio		•	
	General Engineering Science (English program, 7 semester):			1
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester): S Process Engineering: Core qualification: Elective Compulsory	ppecialisation bioprocess Engineering:	ziective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory  Process Engineering: Core qualification: Compulsory			
	1 100000 Engineening. 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	Mass Transfer	
Courses		
Title	Typ Hrs/wk CP	
Heat and Mass Transfer (L0101)	Lecture 2 4	
Heat and Mass Transfer (L0102)	Recitation Section (small) 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		
	<ul> <li>The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchange chemical reactors).</li> <li>They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and therm radiation.</li> <li>The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative to using suitable mass transfer theories.</li> <li>They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.</li> </ul>	
Skills  Personal Competence Social Competence	<ul> <li>The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively.</li> <li>They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows.</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 knowlegde of other courses (In particular the course thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.</li> </ul>	
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-liassignments) and on this basis they can control their learning processes.</li> </ul>	
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42	
Credit points	6	
Examination	Written exam	
Examination duration and scale	120 minutes; theoretical questions and calculations	
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory	
Assignment for the Following		
Assignment for the Following Curricula		
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory	
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory	
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Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, 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	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  The students work on tasks in small groups and present their results in front of all students.	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer     VDI-Wärmeatlas	



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
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	g learning results		
Professional Competence		-		
Knowledge	The students can distinguish and describe different types The students develop an understanding for the course o process, the possibilities of energy saving, and the selecti They have good knowledge of designing methods for sep	f concentration during a separation procession of separation systems		
Skills	Using the gained knowledge the students can select a real energy and material balances The students can use different graphical methods for the content of	lesigning of a separation process and de aration process for a given case based ded material properties from appropriate ses in the experimental lab work. In and the content of the experimental work the content of other lectures and use it to	fine the amount of the on the advantages an sources (diagrams an	oretical stages required and disadvantages of the disadvantages of the disadvantages of the colloquium.
Personal Competence Social Competence	The students can work technical assignments in small gro  The students are able to carry out practical lab work in sr			n them. They are able to
Autonomy	the students are capable to obtain the needed informatio     The students are capable to obtain the needed informatio     The students can proof the state of their knowledge with e	a report.	d assess their quality	
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
	6			
Examination				
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation	0 0 1 7		
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Energy and Enviromental Engineering: C	, ,	
	General Engineering Science (German program, 7 semester): Sp		•	
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	General Engineering Science (German program, 7 semester): Sp	ecialisation Bioprocess Engineering: Cor	mpulsory	y
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	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester): Sp Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation I	ecialisation Bioprocess Engineering: Cor ecialisation Energy and Enviromental En pulsory Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co	mpulsory gineering: Compulsor	у
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Course L0118: Thermal Separation	Processes	
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	dependent Study Time 48, Study Time in Lecture 42	
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	1	
Workload in Hours	Independent Study Time 2, 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	
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		
Тур	Laboratory Course		
Hrs/wk	1		
CP	1		
Workload in Hours			
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.		
	Terms of scientific writing as well as reedback 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			
Literature	G. Brunner: Skriptum Thermische Verfahrenstechnik		
	J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980		
	Sattler: Thermische Trennverfahren, VCH, Weinheim 1995		
	<ul> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> </ul>		
	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,      Separation of the separation processes of the separation processes. Steinkopff,      Separation of the separation processes of the separation processes. Steinkopff,      Separation of the separation processes of the separation processes of the separation processes of the separation processes. Steinkopff,      Separation of the separation processes of the separation		
	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.      Regreting Chamical Engineers, Handbook P. H. Parry, D.W. Groop, L.O. Malanov (Hrsg.). 6th and McGraw Hill. New York, 1994. Illimonnia.		
	<ul> <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>		
	Enzymopadio del redifficione i Offenite		



Module M0892: Chemical R	eaction 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 Engineering	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, physical chemistry, technical thermodynamics I+II as well as computational methods for engineers.			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 cher	nical reaction engineering. They are able to point	out differences betwe	en thermodynamical and	
	kinetical processes. The students have a strong ability to	o outline parts of isothermal and non-isothermal id	eal reactors and to de	scribe their properties.	
Skills	After successful completion of the module, students are	able to:			
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,				
	- determine and compute stable operation points for the	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	dents have a strong ability to organize themselfe	s in small groups to	solve issues in chemica	
	reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers.				
Autonomy	The students are able to obtain further information and	d 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): Speci	alisation Process Engineering: Compulsory			
Curricula	General Engineering Science (German program): Speci				
	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engineering: Comp	ulsory		
	General Engineering Science (German program, 7 sem	ester): Specialisation Bioprocess Engineering: Co	mpulsory		
	Bioprocess Engineering: Core qualification: Compulsory	,			
	General Engineering Science (English program): Specia	alisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Specia	alisation Process Engineering: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engineering: Compu	ılsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Engineering: Cor	npulsory		
	Process Engineering: Core qualification: Compulsory				

	urse L0204: Chemical Reaction Engineering (Fundamentals)		
Тур	Lecture		
Hrs/wk	2		
CP :	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn		
Language	DE		
Cycle	WiSe		
:	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, 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)		
	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 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 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, standard 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 react 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 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, r limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of comp kinetics)		



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
- $R.\ Aris, Elementary\ Chemical\ Reactor\ Analysis, Dover\ Pubn.\ Inc., 2000$
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- $\hbox{G.\,F.\,Froment,\,K.\,B.\,Bischoff,\,J.\,De\,Wilde,\,Chemical\,\,Reactor\,\,Analysis\,\,and\,\,Design,\,John\,\,Wiley\,\,\&\,\,Sons,\,2010}$
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



rse L0244: Chemical Reaction E	ingineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language Cycle	DE WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inc
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass, moles, mole fraction, volume, density, mole fraction, mass, moles,
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, lin dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relat 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 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)
	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 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 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)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous react single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stagreactors, 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 vari kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug freactor, 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 exother 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 cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isother reactors, optimum temperature profile of a reactor)
Literature	lecture notes Raimund Horn
	skript Frerich Keil
	aniper renormen
	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



	Chemical Engineering (Fundamentals)
Typ L	Laboratory Course
Hrs/wk 2	2
CP 2	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer F	Prof. Raimund Horn, Dr. Achim Bartsch
Language [	DE/EN
Cycle S	SoSe
Content F	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 L	Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
F	Praktikumsskript
S	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				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profou chemicals in the environment. Students can give an overvie methods.			
Skills	Students are able to propose appropriate management and m parameters and to assess the potential of pollutants to mig Environmental Technology contributes to sustainable developed.	rate and transform. The students are a	ble to work out well fo	unded opinions on how
Personal Competence				
Social Competence	The students are able to discuss the various technical and sci	entific tasks, both subject-specific and mu	ultidisciplinary. They are	able to develop different
	approaches to the task as a group as well as to discuss their th	eoretical or practical implementation.		
Autonomy	Students can independently exploit sources about of the subje	ct, acquire the particular knowledge and	ranfer it to new problem	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	on Energy and Enviromental Engineering	: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	on Process Engineering: Elective Compul	sory	
	General Engineering Science (German program, 7 semester):	Specialisation Energy and Environmental	Engineering: Compulsor	'n
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineering: Elec	tive Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineering: E	Elective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulso	ory		
	Energy and Environmental Engineering: Core qualification: Co	mpulsory		
	General Engineering Science (English program): Specialisatio	n Energy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program): Specialisatio	n Process Engineering: Elective Compuls	sory	
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Enviromental E	Engineering: Compulsor	у
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Elec	tive Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engineering: E	lective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory			

Course L1387: Practical Exercise E	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)



Module M0956: Measureme	ent Technology for Mechanical and Process	Engineers		
Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Contr	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 engine	eering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundmentals	s of the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static and
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods fo	r different kinds of quantities to be maesured	(Electrical Quantities 1	emperature mechanica
	quantities, Flow, Time, Frequency).	r different kinds of quantities to be macsured	(Licotioai Quarititico, i	emperature, meenamea
	quantities, 110 W, 111116, 11 equation).			
	They can describe important methods of chemical Analysis	(Gas Sensors, Spectroscopy, Gas Chromatog	raphy)	
Skills	Students can select suitable measuring methods to given p	roblems and can use refering measurement de	evices in practice.	
	The students are able to evall, avalain issues in the subis-			
	The students are able to orally explain issues in the subject	ct area of measurement technology and soluti	on approaches as well	as place the issues into
	the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and document	them in a common report.		
Autonomy	Students are able to familiarize themselves with new measu	urement technologies.		
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Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specialis		Compulsory	
Curricula	General Engineering Science (German program): Specialis			
	General Engineering Science (German program): Specialis			
	General Engineering Science (German program): Specialis		:	
	General Engineering Science (German program, 7 semeste	, ,		у
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste			
	Energy and Environmental Engineering: Core gualification:		ruioUTy	
	General Engineering Science (English program): Specialisi	' '	Compulsory	
	General Engineering Science (English program): Specialist		paidory	
	General Engineering Science (English program): Specialist	0 0 1 7		
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semeste		gineering: Compulsor	/
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste			
	Mechanical Engineering: Core qualification: Compulsory	3 3 1		
	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	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 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>
	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>



	iology for Mechanical and Process Engineers
Typ Hrs/wk	Lecture 2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Language	DE
Cycle	
Content	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	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 M0539: Process an	d Plant 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 lear	ning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical processes	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 com	ponent balance models		
	- solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of production co	osts		
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 Proce	ess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Biopr	ocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Speciali	sation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester): Speciali	sation Bioprocess Engineering: Co	mpulsory	
	General Engineering Science (German program, 7 semester): Speciali	isation Energy and Enviromental En	gineering: Elective Co	mpulsory
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Biopro	ocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Proce	ss Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialis	sation Process Engineering: Compu	lsory	
	General Engineering Science (English program, 7 semester): Specialis	sation Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester): Specialis	sation Energy and Enviromental En	gineering: 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	



	Data reconciliation and data validation	
3.	Process Synthesis	
	Decision levels	

Experimental process development

Reactor synthesis

Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams)

## 4. Process safety

## 5. Cost estimation of production plants

Production costs, capital costs, economic evaluation

## Literature

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

J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309

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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 Tec	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 following le	arning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	<ul> <li>name and explain processes and unit-operations of solids p</li> </ul>	ocess engineering,		
	<ul> <li>characterize particles, particle distributions and to discuss the</li> </ul>	eir bulk properties		
Skills	Students are able to			
	choose and design apparatuses and processes for solids pro		ids properties of the pro	duct
	asses solids with respect to their behavior in solids processing	g steps		
	document their work scientifically.			
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				
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 Pro	cess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bio	process Engineering: Compulsory		
	General Engineering Science (German program): Specialisation En	ergy and Enviromental Engineering:	Compulsory	
	General Engineering Science (German program, 7 semester): Speci	alisation Process Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Speci	alisation Bioprocess Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester): Speci	alisation Energy and Enviromental E	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compuls	•		
	General Engineering Science (English program): Specialisation Biop			
	General Engineering Science (English program): Specialisation Ene		Compulsory	
	General Engineering Science (English program): Specialisation Pro			
	General Engineering Science (English program, 7 semester): Specia		•	
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia	uisation Energy and Enviromental Er	igineering: Compulsory	,
	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	
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				
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		3
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	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.		nagement, from Plan	ning and Organisation
	explain the differences between Economics and Management  field of Management	ent and the sub-disciplines in Managen	nent and to name impo	ortant definitions from t
	explain the most important aspects of and goals in Manager	ment and name the most important asp	ects of entreprneurial (	orojects
	describe and explain basic business functions as product			
	ressource management, information management, innovati	on management and marketing		
	<ul> <li>explain the relevance of planning and decision making in</li> </ul>	Business, esp. in situations under mi	ultiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	<ul> <li>state basics from accounting and costing and selected cont</li> </ul>	olling methods.		
Skills	Students are able to analyse business units with respect to Entrepreneurship project in a team. In particular, they are able to	different criteria (organization, obje	ctives, strategies etc	.) and to carry out
	analyse Management goals and structure them appropriate	v		
	analyse organisational and staff structures of companies	,		
	<ul> <li>apply methods for decision making under multiple objective</li> </ul>	s, under uncertainty and under risk		
	analyse production and procurement systems and Business	information systems		
	analyse and apply basic methods of marketing			
	select and apply basic methods from mathematical finance			
	<ul> <li>apply basic methods from accounting, costing and controlling</li> </ul>	g 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	ship project and write a coherent repo	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			
	<ul> <li>to write a report on their project.</li> </ul>			
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 E	ectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation C			
	General Engineering Science (German program): Specialisation Program (German program)			
	General Engineering Science (German program): Specialisation Bi General Engineering Science (German program): Specialisation E	,	compulsory	
	General Engineering Science (German program): Specialisation C	0,	, ,	
	General Engineering Science (German program): Specialisation M		, , , ,	
	General Engineering Science (German program): Specialisation Bi	omedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation N	aval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Spec	cialisation Electrical Engineering: Comp	oulsory	
	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): Spec			
	General Engineering Science (German program, 7 semester): Spec		-	у
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	cialisation Mechanical Engineering, Fo	cus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester): Spec	-	•	
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineerin	g, Focus Materials ir	Engineering Scienc
	Compulsory			



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



Hrs/wk 3 CP 3 Workload in Hours Ir Lecturer P	
CP 3 Workload in Hours Ir Lecturer P	3
Workload in Hours Ir  Lecturer P	
Lecturer P	ndependent Study Time 48, Study Time in Lecture 42
K	Out Christoph III Don't Thousan Display Dun't Christian Lithia Dun't Christian Display Dun't Vatheir Fischer Dun't Councilius Housett Dun't Wolfen
	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfga Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle V	NiSe/SoSe
Content	Modification
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> </ul>
	Important definitions from Management,
	<ul> <li>Developing Objectives for Business, and their relation to important Business functions</li> </ul>
	Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management
	Marketing and Sales
	Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management
	Definitions as information, information systems, aspects of data security and strategic information systems
	Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.  Polymer of the definition population population.
	Relevance of marketing, B2B vs. B2C-Marketing  different techniques from the field of marketing (a.g. cooperis technique), prining strategies.
	<ul> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> </ul>
	Important organizational structures     basics of human ressource management
	Introduction to Business Planning and the steps of a planning process
	Decision Analysis: Elements of decision problems and methods for solving decision problems
	Selected Planning Tasks, e.g. Investment and Financial Decisions
	Introduction to Accounting: Accounting, Balance-Sheets, Costing
	Relevance of Controlling and selected Controlling methods
	Important aspects of Entrepreneurship projects
Literature B	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
E	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
H	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
к	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
P	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
s	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
V	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
V	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	
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	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 cuspocefully etudente have reached the following learning results
•	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts,
	theories, and methods).  • On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and
	establishing links with extended specialized expertise.
	The students are able to outline the state of research on a selected issue in their subject area.
Skills	The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related
	problems.  • With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and
	develop solutions.
	The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence Social Competence	<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 they can uphold their own assessments and viewpoints convincingly.</li> </ul>
Autonomy	<ul> <li>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.</li> <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>
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	laut FSPO
Assignment for the Following	General Engineering Science (German program): Thesis: Compulsory
Curricula	General Engineering Science (German program, 7 semester): Thesis: Compulsory
	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
	Technomathematics: Thesis: Compulsory Process Engineering: Thesis: Compulsory
	1 100000 Engineering. Triesis. Outripulsury