

Module Manual

Bachelor of Science

General Engineering Science (German program)

Cohort: Winter Term 2017

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Program description

Content

The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study, 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 Dagmar Richter Admission Requirements None Recommended Previous Knowledge Cducational Objectives After taking part successfully, students have reached the following learning results Professional Competence

Knowledae

The Non-technical Academic Programms (NTA)

imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, 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 nontechnical academic programms 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 studies.

Teaching and Learning Arrangements

provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with 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, migration 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 abstraction in the B.Sc.

This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions 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.

//s 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,



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

Courses

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



Physics for Engineers (L0368) Physics to Engineers (Problem Solving Course) (L0368) Rectation Section (small) Representation EX. (10368) Rectation Section (small) Recommended Previous Re	Module M0642: Physics for	Engineers			
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Module Responsible Admission Requirements Recommended Previous Knowledge Physics on high school level Calculus and linear algebra on high school level Physics on high school level Calculus and linear algebra on high school level Physics on high school level Calculus and linear algebra on high school level Rowledge Knowledge Knowledge Knowledge Knowledge Knowledge Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics. Students can relate physics topics to technical problems. Skills Students can explain fundamental apperties. Students are able to write meaningful reports on experiments and to discuss the results in a conclusive way. Personal Competence Social Competence Social Competence Social Competence Autonomy Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They or reflect their acquired level of expertise with the help of fecture accompanying measures such as exam typical exam questions. Students are able connect their knowledge with that acquired from other lectures. Workload in Hours Horsendamination Written exam Written examination Written exam Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. General Engineering Science (German program): Core qualification: Compulsory	Physics for Engineers (Problem Solving C	ourse) (L0368)	Recitation Section (small)	1	1
Admission Requirements Recommended Previous Knowledge Calculus and linear algebra on high school level Physics on high school level Students Competence Knowledge Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics. Students can relate physics topics to technical problems. Skills Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise. Students are able to write meaningful reports on experiments and to discuss the results in a conclusive way. Personal Competence Social Competence Social Competence Social Competence Social Competence Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They or reflect their acquired level of expertises with the help of lecture accompanying measures such as exam typical exam questions. Students are able connect their knowledge with that acquired from other lectures. Workload in Hours Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. General Engineering Science (German program): Core qualification: Compulsory	Physics-Lab for ET/ AIW/ GES (L0948)		Laboratory Course	1	2
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Autonomy Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They or reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able 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 attestation. General Engineering Science (German program): Core qualification: Compulsory	Social Competence		ney can present their results ellectively		
reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able connect their knowledge with that acquired from other lectures. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory		within the framework of the problem solving and lab courses.			
reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able connect their knowledge with that acquired from other lectures. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able connect their knowledge with that acquired from other lectures. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
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 attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory	Autonomy				•
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 attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory			e accompanying measures such as exam	typical exam questio	ns. Students are able to
Credit points 6 Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory		connect their knowledge with that acquired from other lectures.			
Credit points 6 Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
Credit points 6 Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
Examination Written exam Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
Examination duration and scale Written Exam: 120 minutes. Physics Lab: 4 handwritten pages preparatory script, assisted transcript and attestation. Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
Assignment for the Following General Engineering Science (German program): Core qualification: Compulsory					
	Examination duration and scale	Written Exam: 120 minutes. Physics Lab: 4 handwritten pages p	preparatory script, assisted transcript and att	estation.	
Curricula Electrical Engineering: Core qualification: Compulsory		General Engineering Science (German program): Core qualification	ation: Compulsory		
	Curricula	Electrical Engineering: Core qualification: Compulsory			

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



Course L0368: Physics for Engineer	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.		



Module M0687: Chemistry				
Courses				
Title		Тур	Hrs/wk	CP
Chemistry I (L0460)		Lecture	2	2
Chemistry I (L0475)		Recitation Section (large)	1	1
Chemistry II (L0465)		Lecture	2	2
Chemistry II (L0476)		Recitation Section (large)	1	1
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	The students are able to name and to describe basic prin bonds), physical chemistry (aggregate states, separating solubility, redox, metals) and organic chemistry (aliphatic natural products, synthetic polymers). Furthermore students a	processes, thermodynamics, kinetics), inorghydrocarbons, functional groups, carbonyl c	ganic chemistry (aci	d/base, pH-value, salts
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				
·	Students are able to take part in discussions on chemical is	sues and problems as a member of an interdi	sciplinary team. The	v can contribute to those
	discussion by their own statements.			,
Autonomy	After successful completion of this module students are a arguments. They can also document their approaches.	ble to solve chemical problems independen	tly by defending pro	oposed approaches with
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 quali	fication: Compulsory		
Curricula	General Engineering Science (German program, 7 semester			
	Civil- and Environmental Engineering: Core qualification: Co			

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



Course L0475: Chemistry I		
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	465: Chemistry II			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload	Independent Study Time 32, Study Time in Lecture 28			
in Hours				
Lecturer	Dr. Christoph Wutz			
Language	DE			
Cycle	WiSe			
Content	- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,			
	- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars			
	- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction			
	- Practical apllications and examples			
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure			
	- Kickelbick: Chemie für Ingenieure (Pearson)			
	- Schmuck: Basisbuch Organische Chemie (Pearson)			

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



Courses				
Title		Тур	Hrs/wk	CP
Electrical Engineering I: Direct Current Networks 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	following 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	General Engineering Science (German program, 7 seme	ester): Core qualification: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	Computational Science and Engineering: Core qualifica	tion: Compulsory		
	Mechatronics: Core qualification: Compulsory			

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

Course L0676: Electrical Engineering	ng 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 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)		Recitation Section (small)	1	1	
Linear Algebra I (L0914)		Recitation Section (large)	1	1	
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	none				
Recommended Previous	School mathematics				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following	ng learning results			
Professional Competence					
Knowledge	Students can name the basic concepts in analysis and li	near algebra. They are able to explain ther	n using appropriate e	xamples.	
	Students can discuss logical connections between these				
	They know proof strategies and can reproduce them.	are capacity and capacity			
	,				
Skills					
Skills	Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of				
	solving them by applying established methods.				
	 Students are able to discover and verify further logical connections between the concepts studied in the course. 				
	For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.				
Personal Competence					
Social Competence	Students are able to work together in teams. They are capable to use mathematics as a common language.				
	• In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to				
	check and deepen the understanding of their peers.				
Autonomy					
	Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know				
	where to get help in solving them.				
	 Students have developed sufficient persistence to be ab 	le to work for longer periods in a goal-orier	ited manner on hard p	oroblems.	
,,, ,, ,, ,,	Industrial Ord True 100 Ct. 1 True 1 to 1				
Workload in Hours Credit points	Independent Study Time 128, Study Time in Lecture 112				
Examination	Written exam				
Examination duration and scale	60 min (Analysis I) + 60 min (Linear Algebra I)				
Assignment for the Following	General Engineering Science (German program): Core qualifications	ation: Compulsory			
Curricula	General Engineering Science (German program, 7 semester): C				
Carrioula	Civil- and Environmental Engineering: Core qualification: Comp				
	Bioprocess Engineering: Core qualification: Compulsory	,			
	Electrical Engineering: Core qualification: Compulsory				
	Energy and Environmental Engineering: Core qualification: Cor	npulsory			
	Computational Science and Engineering: Core qualification: Cor				
	Logistics and Mobility: Core qualification: Compulsory	inpulsory .			
	Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory				
	1 100000 Engineering. Oure qualification. Compulsory				



Course L1010: Analysis I	
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	Foundations of differential and integrational calculus of one variable
	statements, sets and functions natural and real numbers convergence of sequences and series continuous and differentiable functions mean value theorems Taylor series calculus error analysis fixpoint iteration
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1012: Analysis I		
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		
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	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants
Literature	 T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994



Course 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, Prof. Marko Lindner
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants
Literature	 T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994

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



Module M0889: Mechanics I (S Courses Title Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002) Mechanics I (Statics) (L1003)	idaitos	Typ Lecture	Hrs/wk	CP			
Title Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002) Mechanics I (Statics) (L1003)		Lecture		CP			
Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002) Mechanics I (Statics) (L1003)		Lecture		СР			
Mechanics I (Statics) (L1002) Mechanics I (Statics) (L1003)							
Mechanics I (Statics) (L1003)		D 14 - 41	2	3			
		Recitation Section (small)	2	2			
		Recitation Section (large) 1 1					
Module Responsible Pro	of. Robert Seifried						
Admission Requirements nor	ne						
Recommended Previous Sol	lid school knowledge in mathematics and physics.						
Knowledge							
Educational Objectives After	er taking part successfully, students have reached the following learni	ing results					
Professional Competence							
Knowledge The	e students can						
	 describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; 						
	present technical knowledge in stereostatics.						
Skills The	The students can						
	A cycloin the important elements of mathematical / mechanical analysis and model formation, and apply it to the contact of their cum problems:						
	 explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic statical methods to engineering problems; 						
	apply basic statical methods to engineering problems; actimate the reach and houndaries of statical methods and extend them to be applicable to wider problem sets.						
	 estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. 						
Personal Competence							
Social Competence The	The students can work in groups and support each other to overcome difficulties.						
	3. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.						
Autonomy Stu	dents are capable of determining their own strengths and weaknesse	es and to organize their time and lea	arning based on those	е.			
Workload in Hours Inde	ependent Study Time 110, Study Time in Lecture 70						
Credit points 6							
Examination Wri	itten exam						
Examination duration and scale 90	min						
Assignment for the Following Ger	neral Engineering Science (German program): Core qualification: Co	mpulsory					
Curricula Ger	neral Engineering Science (German program, 7 semester): Core qua	lification: Compulsory					
Civ	ril- and Environmental Engineering: Core qualification: Compulsory						
Me	chanical Engineering: Core qualification: Compulsory						
Me	Mechatronics: Core qualification: Compulsory						
Na	val Architecture: Core qualification: Compulsory						

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	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 M0547: Electrical E	ngineering II: Alternating Current Networks ar	nd Basic Devices		
Courses				
Title Electrical Engineering II: Alternating Curre Electrical Engineering II: Alternating Curre		Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 5
Module Responsible	Prof. Christian Becker	,		
Admission Requirements	None			
Recommended Previous	Electrical Engineering I			
Knowledge				
	Mathematics I			
	Direct current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students are able to reproduce and explain fundamental th			
	describe networks of linear elements using a complex notation			
	of alternating currents in the area of electrical engineering. Sta as well as their impact on simple circuits.	idents are capable of explaining the benav	ior of fundamental pas	ssive and active devices
Skills	Students are capable of calculating parameters within simple currents. They can appraise the fundamental effects that may of			
	circuits such as oscillating circuits, filter, and matching networ	ks quantitatively and dimension elements	by means of a design.	. They can motivate and
	justify the fundamental elements of an electrical power supply	(transformer, transmission line, compensat	ion of reactive power,	multiphase system) and
	are qualified to dimension their main features.			
Personal Competence				
Social Competence	Students are able to work together on subject related tasks in s	mall groups. They are able to present their	results effectively (e.g.	during a week of project
	work).			
Autonomy	Students are capable to gather necessary information from the			
	to continually reflect their knowledge by means of activities that			
	Based on respective feedback, students are expected to adj knowledge obtained in this lecture and the content of other lect	• • • • • • • • • • • • • • • • • • • •		mections between their
	The state of the s	a	3-2-a, a.i.a / iliaiyolo).	
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 qualific			
Curricula	General Engineering Science (German program, 7 semester):	Core qualification: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	Computational Science and Engineering: Core qualification: C Mechatronics: Core qualification: Compulsory	ompuisory		
	wechanonics: Core quantication: Compulsory			



Course L0178: Electrical Engineerin	g II: Alternating Current Networks and Basic Devices
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	
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)



als of Mechanical Engineering Design			
	Тур	Hrs/wk	СР
Title Fundamentals of Mechanical Engineering Design (L0258)		2	3
lesign (L0259)	Recitation Section (large)	2	3
Prof. Dieter Krause			
None			
Basic knowledge about mechanics and production eng Internship (Stage I Practical)	ineering		
After taking part successfully, students have reached the follow	ing learning results		
After passing the module, students are able to:			
 explain requirements, selection criteria, application so dimensioning calculations. 		machine elements, in	dicate the background o
transfer knowledge learned in the module to new require.	ements and tasks (problem solving skills).	,	
Students are able to discuss technical information in the	electure supported by activating methods.		
Charles are alle to independently decrease their security			
	•	ntent e.a. by using the	video recordings of the
lectures.	na to resuptiatate postify anderstood sor	none e.g. by doing the	video recordings of the
Independent Study Time 124, Study Time in Lecture 56			
Written exam			
General Engineering Science (German program): Core qualific	ation: Compulsory		
General Engineering Science (German program, 7 semester):	Core qualification: Compulsory		
Energy and Environmental Engineering: Core qualification: Co	mpulsory		
General Engineering Science (English program): Core qualific	ation: Compulsory		
	lactive Compulsory		
	rective Compulsory		
	Design (L0258) Design (L0259) Prof. Dieter Krause None Basic knowledge about mechanics and production enging a Internship (Stage I Practical) After taking part successfully, students have reached the followow and the followow are successfully, students are able to: explain basic working principles and functions of maching explain requirements, selection criteria, application so dimensioning calculations. After passing the module, students are able to: accomplish dimensioning calculations of covered maching transfer knowledge learned in the module to new required recognize the content of technical drawings and schement etchnically evaluate basic designs. Students are able to discuss technical information in the students are able to acquire additional knowledge and lectures. Independent Study Time 124, Study Time in Lecture 56 Written exam 120 General Engineering Science (German program): Core qualification: Congeneral Engineering Science (English program): Core qualification: Congeneral Engineering Science (English program): Core qualification: Congeneral Engineering Science (English program): Core qualification: Congeneral Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory	Prof. Dieter Krause None Basic knowledge about mechanics and production engineering Internship (Stage I Practical) After taking part successfully, students have reached the following learning results After passing the module, students are able to: explain requirements, selection criteria, application scenarios and practical examples of basic dimensioning calculations. After passing the module, students are able to: explain requirements, selection criteria, application scenarios and practical examples of basic dimensioning calculations. After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills) recognize the content of technical drawings and schematic sketches, technically evaluate basic designs. Students are able to discuss technical information in the lecture supported by activating methods. Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood con lectures. Independent Study Time 124, Study Time in Lecture 56 Written exam 120 General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program): Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Mechatronical Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	Prof. Dieter Krause None Basic knowledge about mechanics and production engineering Internship (Stage I Practicat) After taking part successfully, students have reached the following learning results After passing the module, students are able to: explain basic working principles and functions of machine elements, explain basic working principles and functions of machine elements, explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, in dimensioning calculations. After passing the module, students are able to: explain basic working principles and functions of machine elements, explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, in dimensioning calculations. After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, technically evaluate basic designs. Students are able to discuss technical information in the lecture supported by activating methods. Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the lectures. Written exam 120 General Engineering Science (German program, 7 semester): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Mechanical Engineering Science (English program): Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0258: Fundamentals of Me	chanical Engineering Design
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Lecture
	Introduction to 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)
	Calculation methods for dimensioning the following machine elements:
	Springs Avia 0 a batta
Literature	 Axis & shafts 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., Voßlek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

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



Module M0671: Technical 1	Thermodynamics 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 lea	rning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamics. They know the	he relation of the kinds of energy ac	cording to 1st law of T	hermodynamics and are
	aware about the limits of energy conversions according to 2 nd law of	Thermodynamics They are able to d	listinauish hetween sta	ite variables and process
	variables and know the meaning of different state variables like tem		-	•
	able to draw the Carnot cycle in a Thermodynamics related diagram.		-	
	use the related equations of state. They know the meaning of a fundar			-
Skills	Students are able to calculate the internal energy, the enthalpy, the ki	inetic and the potential energy as w	ell as work and heat fo	r simple change of states
S.i.iii	and to use this calculations for the Carnot cycle. They are able to ca			
	variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an appr	roach.		
Autonomy	Students are able to define independently tasks, to get new knowledge		s to find ways to use th	e knowledge in practice
, atomorny	election are used to define mappingority across, to get non-knowledge	o nom oxioting knowledge de nom e	o to ima mayo to accoun	- In this work of the same of
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Core qualification:	Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Core q	ualification: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulso	•		
	General Engineering Science (English program): Core qualification: 0			
	General Engineering Science (English program, 7 semester): Core qu			
	Computational Science and Engineering: Specialisation Engineering	Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective	Compulsory		
	Process Engineering: Core qualification: Compulsory			



T	Locture
	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	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 Thermody	rnamics I
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title 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	NN			
Admission Requirements	none			
Recommended Previous	Mechanics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law.			
Skills	The students apply the mathematical/mechanical analysis and modeling.			
	The students apply the fundamental methods of elasto statics to simply engineering problems.			
	The students estimate the validity and limitations of the introduced methods			
	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): Core qualification: Compulsory			
Curricula	General Engineering Science (German program, 7 semester): C			
	Civil- and Environmental Engineering: Core qualification: Comp	ılsory		
	Mechanical Engineering: Core qualification: Compulsory			
	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. Benedikt Kriegesmann
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
	182. Pearson (2005)
	1 42. Fedisui (2003)

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. Benedikt Kriegesmann
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. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. Personal Competence Social Competence Students are able to work together in teams. They are capable to use mathematics as a common language.	0				
Title					
Analysis II (L1026)					
Analysis II (L1026) Analysis II (L1027) Analysis II (L0916) Analys			Тур		
Acaylas LL LOZP Clear Agebra LL Coder Clear Clea					2
Licear Algebra II (L0916) Licear Algebra II (L0916) Prof. Anusch Taraz Admission Requirements Recommended Previous Module Responsible Recommended Previous Mathematics I Recommended Previous Rowledge Educational Objectives Alter taking part successfully, students have reached the following learning results Professional Competence Knowledge Students can discuss logical connections between these concepts. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples and innear algebra with the help of the concepts studied in this course. Moreover, they are capable of illustrating these connections with the results are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. Personal Competence Social Competence Social Competence Social Competence In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they and design example check and deepen the understanding of their peers.	Analysis II (L1026)		Recitation Section (large)	1	1
Linear Algebra II (Li0916) Module Responsible Mathematics I Recommended Previous Knowledge Educational Objectives Affirm king part successfully, students have reached the following learning results Professional Competence Knowledge Students can make further concepts in analysis and linear algebra. They are capable of illustrating these connections with the help of example. They know proof strategies and can reproduce them. Skills Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of illustrating these connections with the help of example. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. Personal Competence Social Competence Social Competence Social Competence I Students are able to work together in teams. They are capable to use mathematics as a common language. I students are able to work together in teams. They are capable to use mathematics as a common language. I doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design example check and deepen the understanding of their peers.	Analysis II (L1027)		Recitation Section (small)	•	1
Module Responsible Prof. Anusch Taraz	Linear Algebra II (L0915)		Lecture	2	2
Module Responsible Prof. Anusch Taraz none				1	1
Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Knowledge Students can make further concepts in analysis and linear algebra. They are capable of illustrating these connections with the help of example. Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of illustrating these connections with the help of examples. Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. Personal Competence Social Competence Social Competence Obtains 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 example check and deepen the understanding of their peers.	•		Recitation Section (large)	1	1
Recommended Previous Knowledge					
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Personal Competence Social Competence In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design example check and deepen the understanding of their peers. Autonomy Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and be sometimes as a common language. Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and be sometimes as a common language.			connections between the concepts studied in	the course.	
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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 example check and deepen the understanding of their peers. Autonomy Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and their own.					
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Workload in Hours Independent Study Time 128, Study Time in Lecture 112 Credit points 8					
	· · · · · · · · · · · · · · · · · · ·	Written exam			
		60 min (Analysis II) + 60 min (Linear Algebra II)			
	· ·	General Engineering Science (German program): Core qualification: Compulsory			
Curricula General Engineering Science (German program, 7 semester): Core qualification: Compulsory	Curricula	General Engineering Science (German program, 7 semester): Core qualification: Compulsory			
Civil- and Environmental Engineering: Core qualification: Compulsory		Civil- and Environmental Engineering: Core qualification: Com	npulsory		
Bioprocess Engineering: Core qualification: Compulsory		Bioprocess Engineering: Core qualification: Compulsory			
Electrical Engineering: Core qualification: Compulsory		Electrical Engineering: Core qualification: Compulsory			
Energy and Environmental Engineering: Core qualification: Compulsory		Energy and Environmental Engineering: Core qualification: Co	ompulsory		
Computational Science and Engineering: Core qualification: Compulsory					
			50pa.001y		
Logistics and Mobility: Core qualification: Compulsory					
Mechanical Engineering: Core qualification: Compulsory	l l				
Mechatronics: Core qualification: Compulsory		Machatronics: Coro qualification: Compulsory			
Naval Architecture: Core qualification: Compulsory		Mechanomics. Core quantication. Compulsory			
Process Engineering: Core qualification: Compulsory					



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

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

Course L1027: Analysis II	
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		
CP	2	
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28	
Lecturer	of. Anusch Taraz, Prof. Marko Lindner	
Language	E	
Cycle	SoSe SoSe	
Content	 linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: QR-decomposition, normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition system of linear differential equations 	
Literature	 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 	



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

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



Module M0688: Technical 1	Fhermodynamics 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 Technical Thermodynamics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge	Students are familiar with different cycle processes like Joule, Otto	Diesel Stirling Seiliger and Clausius-	Rankine They are abl	e to derive energetic a
ruiemeage	exergetic efficiencies and know the influence different factors. The			
	cooling cycle). They have increased knowledge of steam cycles			
	know the laws of gas mixtures, especially of humid air processes			
	knowledge in gas dynamics and know the definition of the speed of			y are provided with be
	Niewiedge in gas dynamies and know the deminion of the speed of	or sound and know about a Lavar nozzlo		
Clilla	Chindren to any other transfer the control of the state o	shaire Larresson - Francially they are		
Skills	Students are able to use thermodynamic laws for the design of te			
	balances and by this to optimise technical processes. They are a		ns in regard to an ou	triowing gas from a ta
	They are able to transform a verbal formulated message into an ab	ostract formal procedure.		
Personal Competence Social Competence Autonomy	The students are able to discuss in small groups and develop an a Students are able to define independently tasks, to get new knowledge to the students are able to define independently tasks, to get new knowledge.		s to find ways to use th	ne knowledge in practi
Warkland in Hours	Independent Study Time 104 Study Time in Leature 56			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Core qualification			
Curricula	General Engineering Science (German program, 7 semester): Cor	e qualification: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp			
	General Engineering Science (English program): Core qualification	n: Compulsory		
	General Engineering Science (English program, 7 semester): Core	e qualification: Compulsory		
	Computational Science and Engineering: Specialisation Engineer	ing Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elect	tive 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	
	0. Open sytems with constant flow rates	
	11. Combustion processes	
	12. Special fields of Thermodynamics	
Literature	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009	
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012	
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993	

Course L0450: Technical 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				
Title	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 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				
	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			
	 Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division 			
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining			
	Memories: Memory hierarchies, SRAM, DRAM, caches			
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses			
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composit			
	computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and s			
	components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and c			
	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 so			
	executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layer			
	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 sy			
	performance and to propose feasible options.			
Personal Competence				
Social Competence				
	3,			
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Autonomy	Students are able to acquire new knowledge from specific fiterature and to associate this knowledge with other classes.			
Workload in Hours				
	Independent Study Time 124, Study Time in Lecture 56			
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56			
Workload in Hours Credit points Examination	Independent Study Time 124, Study Time in Lecture 56 6 Written exam			
Workload in Hours Credit points Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 90 minutes, contents of course and labs			
Workload in Hours Credit points Examination	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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			
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Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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 Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German Program, 7 semester): Spe			
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Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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 Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory General Engineering Science (German program, 7 semest			
Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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 Mechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productomy General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productomy General Engineering Science			
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Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	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 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 Mechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productomy General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productomy General Engineering Science			
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Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation River Individual 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 Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productional Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Productional Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Co			
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Workload in Hours Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 124, Study Time in Lecture 56 8 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 Science; Compulsory General Engineering Science (German program, 7 semester): Specialisation Science; Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Science (Lapineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering Science (Lapineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product Development and Product Development and Product Development and Product Development Science (German program): C			
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Technomathematics: Specialisation II. Informatics: Elective Compulsory



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

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

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



Madula M0050, Machanica	III /Livelya statica Vinamatica Vinatica			
wodule MU959: Mechanics	III (Hydrostatics, Kinematics, Kinetics I)			
Courses				
Title		Тур	Hrs/wk	СР
Mechanics III (Hydrostatics, Kinematics, K	inetics I) (L1134)	Lecture	3	3
Mechanics III (Hydrostatics, Kinematics, Kinetics I) (L1135)		Recitation Section (small)	2	2
Mechanics III (Hydrostatics, Kinematics, K	inetics I) (L1136)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mathematics I, II, Mechanics I (Statics)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students can			
	and the state of t	and and a contraction		
	describe the axiomatic procedure used in mecha	anical contexts;		
	explain important steps in model design;			
	present technical knowledge in stereostatics.			
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 hydrostatical, kinematic and kinetic methods to engineering problems; 			
	estimate the reach and boundaries of statical me	ethods 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	r to overcome difficulties.		
·				
Autonomy	Students are capable of determining their own strengths	s and weaknesses and to organize their time and lea	arning based on thos	e.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Core	qualification: Compulsory		
Curricula	General Engineering Science (German program, 7 sem	ester): Core qualification: Compulsory		
	Mechanical Engineering: Core qualification: Compulsor	у		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			

Course L1134: Mechanics III (Hydrostatics, Kinematics, Kinetics I)		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	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	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



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



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 Differential	tial Equations) (L1031)	Lecture	2	2	
Differential Equations 1 (Ordinary Different	tial Equations) (L1032)	Recitation Section (small)	1	1	
Differential Equations 1 (Ordinary Different	tial Equations) (L1033)	Recitation Section (large)	1	1	
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	none				
Recommended Previous	Mathematics I + II				
Knowledge	Mathematics (+ II				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results			
Professional Competence					
Knowledge	a Children and many the book according to	and of analysis and differential acceptance. The		- 46	
	Students can name the basic concepts in the .	area of analysis and differential equations. The	ey are able to explai	n them using appropriate	
	examples.				
	Students can discuss logical connections between		ig these connections w	ith the help of examples.	
	They know proof strategies and can reproduce	them.			
Skills					
	 Students can model problems in the area of a 	nalysis and differential equations with the help of	f the concepts studied	in this course. Moreover,	
	they are capable of solving them by applying es	stablished methods.			
	 Students are able to discover and verify further 	logical connections between the concepts studied	in the course.		
	For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.				
Paraeral Competence					
Personal Competence					
Social Competence	 Students are able to work together in teams. Th 	ev are capable to use mathematics as a common l	anguage.		
		 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 			
	check and deepen the understanding of their p		a	y dan doorgin oxampioo to	
	check and deepen the understanding of their p	6613.			
Autonomy	• Ctudents are concluded their unders	tanding of compley concents on their own. They	oon oncoify onco aug	stiana praciaaly and know	
	Students are capable of checking their unders	landing of complex concepts on their own. They	can specify open ques	silons precisely and know	
	where to get help in solving them.				
	 Students have developed sufficient persistence 	e to be able to work for longer periods in a goal-orie	ented manner on hard	problems.	
Workload in Hours	Independent Study Time 128, Study Time in Lecture 1	12			
Credit points	8				
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	e qualification: Compulsory			
Curricula	General Engineering Science (German program, 7 ser	nester): Core qualification: Compulsory			
	Civil- and Environmental Engineering: Core qualification	on: Compulsory			
	Bioprocess Engineering: Core qualification: Compulso	ory			
	Computer Science: Core qualification: Compulsory				
	Electrical Engineering: Core qualification: Compulsory				
	Energy and Environmental Engineering: Core qualification				
	General Engineering Science (English program): Core				
	General Engineering Science (English program, 7 sem				
	Computational Science and Engineering: Core qualific				
	Mechanical Engineering: Core qualification: Compulso	pry			
	Mechatronics: Core qualification: Compulsory				
Naval Architecture: Core qualification: Compulsory					
	Process Engineering: Core qualification: Compulsory				
	Frocess Engineering: Core qualification: Compulsory				



Course L1028: Analysis III	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		
Literature	Theorems of Gauß and Stokes http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html		

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

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

Course L1031: Differential Equations 1 (Ordinary Differential Equations)			
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28		
Lecturer	izenten 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	

ourse 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	



Module M1121: Programmi	ng in C		
Courses			
Γitle	Тур	Hrs/wk	СР
Programming in C (L0083)	Lecture	1	1
Programming in C (L1488)	Laboratory Course	1	1
Module Responsible	Prof. Siegfried Rump		
Admission Requirements	None		
Recommended Previous	Elementary PC handling skills		
Knowledge	Elementary mathematical skills		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	The students know by heart the basic syntax of C programming as well as its meaning, intent and purpose.		
	They know the fundamental components and principles of 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 object oriented programming in C++.		
Skills	The students know how to use an integrated development environment 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 Programs.		
	They can solve simple algorithmic problems on their own and can model and program their solutions in C language.		
	The students are able to solve selected exercises from other areas of their study like mathematics,		
	mechanics, electrical engineering or physics with the aid of small C programs/-projects numerically.		
Personal Competence	The state of the s		
Social Competence			
	programming errors and to present their results.		
	They are able to explain simple phenomena to each other directly at the PC.		
Autonomy	The students prepare themselves using the given teaching material and solve the given		
Autonomy	programming exercises on their own.		
	Additionally, they write small C programs to understand and check addressed issues and also to		
	gain a certain programming experience.		
	For details beyond the scope of the lecture the students inform themselves using the stated		
	literature and / or by supplementary own research.		
	meratare and for by supplementary own research.		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Credit points	2		
Orean points	I		
	Homework		
	Homework 1-2 coding tasks weekly		
Examination			
Examination Examination duration and scale	1-2 coding tasks weekly		
Examination Examination duration and scale Assignment for the Following	1-2 coding tasks weekly General Engineering Science (German program): Core qualification: Compulsory		



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	WiSe
Content	C-Programming:
	 basic data types (integers, floating point numbers, characters, boolean values) 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 (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers) important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h) example programs for technical and mathematical applications
Literature	Kernighan, Brian W (Ritchie, Dennis M.;) The C programming language ISBN: 9780131103702 Upper Saddle River, NJ [u.a.]: Prentice Hall PTR, 2009
	Sedgewick, Robert Algorithms in C ISBN: 0201316633 Reading, Mass. [u.a.]: Addison-Wesley, 2007 Kaiser, Ulrich (Kecher, Christoph.;) C/C++: Von den Grundlagen zur professionellen Programmierung ISBN: 9783898428392 Bonn: Galileo Press, 2010 Wolf, Jürgen C von A bis Z: das umfassende Handbuch ISBN: 3836214113 Bonn: Galileo Press, 2009

ourse 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	WiSe
Content	See interlocking course
Literature	See interlocking course



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ourses				
itle troduction to Control Systems (L0654)	Typ Lecture		Hrs/wk 2	CP 4
troduction to Control Systems (L0655)	Recitation Section (sm		2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge			:	- f f t d
	 Students can represent dynamic system behavior in time and frequency domain, and can systems 	n in particular expla	in properties	of first and second
	They can explain the dynamics of simple control loops and interpret dynamic properties i	in terms of frequenc	v response ai	nd root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.	torrilo or iroquorio	, 100ponioo a.	
	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 results.	response		
	They can explain issues arising when controllers designed in continuous time domain ar	re implemented digi	tally	
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 free	quency response te	chniques	
	They can calculate discrete-time approximations of controllers designed in continuous-tire	me and use it for dig	gital implemer	ntation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out	t these tasks		
Personal Competence				
•		ato their controller de	noiano	
Social Competence				- 14
Autonomy	Students can obtain information from provided sources (lecture notes, software documentati problems.	ion, experiment gui	ides) and use	e it when solving
	problems.			
	They can assess their knowledge in weekly on-line tests and thereby control their learning progr	ress.		
	They can assess their knowledge in weekly on-line tests and thereby control their learning progr	ress.		
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Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	ress.		
Credit points	Independent Study Time 124, Study Time in Lecture 56	ress.		
Credit points Examination	Independent Study Time 124, Study Time in Lecture 56 6 Written exam	ress.		
Credit points Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min	ress.		
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program): Core qualification: Compulsory			
Credit points Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science	e: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engine	s: Compulsory eering: Compulsory		
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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

 $General\ Engineering\ Science\ (English\ program,\ 7\ semester):\ Specialisation\ Mechanical\ Engineering,\ Focus\ Aircraft\ Systems\ Engineering:\ Compulsory\ Specialisation\ Mechanical\ Engineering:\ Compulsory\ Mechanical\ Engineering:\ Mech$

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
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems
	Linear systems, differential equations and transfer functions
	First and second order systems, poles and zeros, impulse and step response
	Stability
	Feedback systems
	Principle of feedback, open-loop versus closed-loop control
	Reference tracking and disturbance rejection
	Types of feedback, PID control
	System type and steady-state error, error constants
	Internal model principle
	Root locus techniques
	Root locus plots
	Root locus design of PID controllers
	Frequency response techniques
	Bode diagram
	Minimum and non-minimum phase systems
	Nyquist plot, Nyquist stability criterion, phase and gain margin
	Loop shaping, lead lag compensation
	Frequency response interpretation of PID control
	Time delay systems
	Root locus and frequency response of time delay systems
	Smith predictor
	Digital control
	Sampled-data systems, difference equations
	Tustin approximation, digital implementation of PID controllers
	Software tools
	Introduction to Matlab, Simulink, Control toolbox
	Computer-based exercises throughout the course

Literature	Werner, H., Lecture Notes "Introduction to Control Systems"
	G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009
	K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010



Course L0655: Introduction 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			
module mor 40. Oll dotal all P	analysis i			
Courses				
Title		Тур	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	ng learning results		
Professional Competence				
Knowledge	After successfully completing this module, students can express	the basic aspects of linear frame analysis	of statically determina	ite systems.
Skills	After successful completion of this module, the students are al	ole to distinguish between statically determ	ninate and indetermin	nate structures. They are
	able to analyze state variables and to construct influence lines of			•
		, ,		
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdisciplinary discu	ecione		
	defend their own work results in front of others	5510115,		
	promote the scientific development of colleagues			
	Furthermore, they can give and accept professional con-	structive criticism		
A :	The state of the s	and the terms for the edition of the	d to colf consequent	to a material constraint of the
Autonomy	The students are able work in-term homework assignments. Du	ie to the in-term feedback, they are enable	d 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 Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): S		ry	
	Civil- and Environmental Engineering: Core qualification: Comp	·		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): S		у	
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		

Course L0666: Structural Analysis	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	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	l
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0613: Reinforced	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 materials.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ring 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 structural members.			
Skills	The students are able to apply basic procedures of the constructures and to design them for bending and bending with a construction sketches and draw up technical descriptions.			•
Personal Competence				
Social Competence				
Autonomy	The students are able to carry out simple tasks in the conception	on 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): Specialisation	on Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Civil Engineering: Compulso	ry	
	Civil- and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Specialisation	n Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Civil Engineering: Compulso	ry	

Course L0896: Project Seminar Con	ncrete 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	e 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	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	



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Module M0706: Geotechnic	S I			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L0551)		Recitation Section (large)	2	2
Soil Mechanics (L1493)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Modules:			
Knowledge	- Markey Land III			
	Mechanics I-II			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students know the basics of soil mechanics	s as the structure and characteristics of soil, stress	distribution due to we	eight, water or structures
	consolidation and settlement calculations, as well	as failure of the soil due to ground- or slope failure.		
Skills	After the successful completion of the module the	students should be able to describe the mechanical	properties and to evalu	uate them with the help o
	geotechnical standard tests. They can calculate st	resses and deformation in the soils due to weight or in	fluence of structures. T	hey are are able to prove
	the usability (settlements) for shallow foundations.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
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	General Engineering Science (German program, 7	semester): Specialisation Civil Engineering: Compuls	ory	
	Civil- and Environmental Engineering: Core qualifi	cation: Compulsory		
	General Engineering Science (English program): S	Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
	General Engineering Science (English program, 7	semester): Specialisation Civil Engineering: Compulsi	ory	

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



Course L0551: Soil Mechanics	ourse 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	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
	Mathematics 1-3
Recommended Previous Knowledge	mainemailes 1-3
Kilowieuge	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathematik 1-3 is exp Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful but not required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are
J	to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic s
	and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which
	caused by the transition of a continuous-time signal to a discrete-time signal.
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can a
	the impact of LTI systems on the signal properties in time and frequency domain.
Personal Competence	
Social Competence	The students can jointly solve specific problems.
·	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the I period by solving tutorial problems, software tools, clicker system.
Wester de De Herre	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engine
	Compulsory Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
l l	
	Computational Science and Engineering: Core qualification: Compulsory



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals and Systems	
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	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 M0744: Structural A	Analysis II			
Courses				
Title		Тур	Hrs/wk	CP
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				
Knowledge	Mechanics I/II Methanics I/II			
	Mathematics I/II Differential Equations I			
	Structural Analysis I			
	- Structurary Mary Stori			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
Knowledge	After successful completion of this module, students can express	the basic aspects of linear frame analysis	of statically indeterm	nate systems.
Chille	After a consequence of the conse		4 indicana a linea af ata	
Skills	After successful completion of this module, the students are able and spatial frame and truss structures.	to analyze state variables and to constitut	a iniliderice lines of sta	llically indefinitiate plane
	and spatial frame and tides structures.			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdisciplinary discuss	sions,		
	defend their own work results in front of others			
	promote the scientific development of colleagues			
	Furthermore, they can give and accept professional const	ructive criticism		
Autonomy	The students are able to work in term homowork assignments	Due to the in-term foodback they are a	unabled to solf access	their learning progress
Autonomy	The students are able to work in-term homework assignments. during the lecture period, already.	Due to the in-term leedback, they are e	mabieu to seir-asses:	s their learning progress
	asing and rotatio portion, arroady.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
	6			
	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation	Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Sp			
	Civil- and Environmental Engineering: Core qualification: Compu			
	General Engineering Science (English program): Specialisation	3: 11 15 1 0	mouleony	
i i		Sivii- and Enviromental Engeneering: Col	привогу	

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



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



Courses				
itle		Тур	Hrs/wk	СР
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 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 field of Management 	and the sub-disciplines in Managem	ent and to name impo	ortant definitions from t
	explain the most important aspects of and goals in Management	ent and name the most important aspe	ects of entreprneurial r	projects
	describe and explain basic business functions as production			
	ressource management, information management, innovation	management and marketing		
	 explain the relevance of planning and decision making in E 	usiness, esp. in situations under mu	Itiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	 state basics from accounting and costing and selected contro 	ling methods.		
Skills	Students are able to analyse business units with respect to of Entrepreneurship project in a team. In particular, they are able to	ifferent criteria (organization, object	ctives, strategies etc) and to carry out
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives,	under uncertainty and under risk		
	analyse production and procurement systems and Business i	formation systems		
	 analyse and apply basic methods of marketing 			
	select and apply basic methods from mathematical finance to			
	 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 entrepreneurs 	nip project and write a coherent repor	t on the project	
	to communicate appropriately and			
	 to cooperate respectfully with their fellow students. 			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	 to write a report on their project. 			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Elec	trical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Cor			
	General Engineering Science (German program): Specialisation Pro			
	General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Ene		ompulsory	
	General Engineering Science (German program): Specialisation Civil	• •		
	General Engineering Science (German program): Specialisation Med		. ,	
	General Engineering Science (German program): Specialisation Biol	nedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Nav	al Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia		•	
	General Engineering Science (German program, 7 semester): Specia General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	·	-	
	General Engineering Science (German program, 7 semester): Specia	·	•	
	General Engineering Science (German program, 7 semester): Specia	, , , , , , , , , , , , , , , , , , , ,		
	General Engineering Science (German program, 7 semester): Specia			у
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineering, Foo	cus Mechatronics: Cor	npulsory
	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 in	Engineering Science
	Compulsory General Engineering Science (German program, 7 semester): Sp	oialization Machanical Engineering	Facus Theorytical A	Analanainal Fanianasi
				decusulcar Engineeri



Compulsory

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

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

 $\label{thm:compulsory} \textbf{General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory and the state of the sta$

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

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

Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Mana	gement
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

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



wodule wossu: Principles of	f Building Materials and Building Ph			
		193103		
Courses				
		T	l lun hade	CP
Title		Тур	Hrs/wk	2
Building Physics (L0217) Building Physics (L0219)		Lecture Recitation Section (large)	1	2
Building Physics (L0219)		Recitation Section (small)	1	1
Principles of Building Materials (L0215)		Lecture	2	2
	Prof. Frank Schmidt-Döhl			
•	None			
Recommended Previous	Knowledge of physics, chemistry and mathematic	s from school		
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
1	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 processe and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protectio against moisture, coldness, fire and noise.			
	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 learn the very extensive specialist knowledge.			
Autonomy .	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 stündige Klausur			
Assignment for the Following	General Engineering Science (German program):	: Specialisation Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program,	7 semester): Specialisation Civil Engineering: Compulso	ory	
	Civil- and Environmental Engineering: Core quali	fication: Compulsory		
	General Engineering Science (English program):	Specialisation Civil- and Environmental Engeneering: Co	mpulsory	
	General Engineering Science (English program,	7 semester): Specialisation Civil Engineering: Compulso	ry	
	Technomathematics: Specialisation III. Engineering	ng Science: Elective Compulsory		

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
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L0247: Building Physics	
Тур	Recitation Section (small)
Hrs/wk	1
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	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	uroe I			
wodule woo i i: Steel Struct	ures 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				
Knowledge	Structural analysis I, Structural analysis II			
	Mechanics I, Mechanics II			
	 Building Materials and Building Chemistry 			
	 Principles of Building Materials and Building Physics 			
Educational Objectives	After taking part successfully, students have reached the foll	owing 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 ten 	sion, 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, force	es and resistances.		
	They can check the ultimate limit state and the serviceability	of simple members in tension, compression a	nd bending.	
Personal Competence				
Social Competence	After participation of an optional course (building of a simp	le truss) they are able to organize themselve	s in groups. They will	be successful in guided
, and the second	building a truss with bolted connections according to design		•	-
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Civil- and Enviromental Engeneering: Co	ompulsory	
Curricula	General Engineering Science (German program, 7 semeste	r): Specialisation Civil Engineering: Compulso	ry	
	Civil- and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisa	tion Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsor	ry	

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



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



Module M0631: Concrete S	Structures II			
^				
Courses		_		
Title		Тур	Hrs/wk	CP
Project Concrete Structures II (L0894)		Project Seminar	1	1
Concrete Structures II (L0348) Concrete Structures II (L0349)		Lecture Recitation Section (large)	3	1
Module Responsible	Prof. Günter Rombach	nectiation section (large)	'	'
Admission Requirements	none			
Recommended Previous	none			
Knowledge	Knowledge of loads on structures and combination of	actions		
Knowledge	 Basics of safety format are required. 			
	Knowledge in design of beams and columns for ultimate.	ate limit state		
	Lecture 'Concrete Structures I'			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	The students know the basic principles which arev required f	or design of reinforced concrete structures. T	hey know the various	methods to estimate the
	member forces in simple one and two-way slabs.			
Skills	The students can design reinforced concrete structure	in the ultimate limit state (shear hending to	rsion) and in the servi	ceahility limit state (crac
	and deflection control) including detailing (anchorage		sion, and in the servi	ocability illilit state (orac
	The students can estimate the member forces of simple.	,		
	The students know the content and the layout of a stru			
	state in a site of the first and the layout of a site			
Personal Competence				
Social Competence	Cooperation in a project work, where they design in a team a	real concrete building and present the results	at the end.	
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester)	: Specialisation Civil Engineering: Elective C	ompulsory	
	Civil- and Environmental Engineering: Core qualification: Cor	mpulsory		
	General Engineering Science (English program): Specialisati	on Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Civil Engineering: Elective Co	mpulsory	

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



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

Course L0349: Concrete Structures	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	



Module M0728: Hydraulic E	ngineering I			
Courses				
Title		Тур	Hrs/wk	CP
Hydrology (L0909)		Lecture	1115/WK	1
Hydrology (L0956)		Problem-based Learning	1	2
Hydromechanics (L0615)		Lecture	2	2
Hydromechanics (L0616)		Recitation Section (large)	1	1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Mathematics I, II and III			
Knowledge	Mechanik I und II			
Educational Objectives	After taking part successfully, students have reached the following learnin	g results		
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.		hydrological water cycle.	
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Besides this, they are able to apply basi 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 analyze and assess respective measurements.		simple reservoir/storage	
Personal Competence Social Competence Autonomy	The students are able to prepare and present technical presentations for students can provide each other with feedback and suggestions on the strategy on an individual basis.		reflecting their study	techniques and learning
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 includes calculations tasks.	tasks with respect to the gener	al understanding of	the lecture contents and
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- an	d Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Specialisat	-		
2.3.10	Civil- and Environmental Engineering: Core qualification: Compulsory	3 - xg xpaiooi	•	
	General Engineering Science (English program): Specialisation Civil-and	Henviromental Engeneering: Con	mnulsory	
	General Engineering Science (English program, 7 semester): Specialisation			
	deneral Engineering Science (English program, 7 semester). Specialisati	on own Engineering. Compulsor	у	

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



Course L0956: Hydrology	
Тур	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
	Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde

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

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



Module 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	Mechanics I-II			
	Geotechnics I			
	Geotechnics i			
Educational Objectives	After taking part successfully, students have reache	d 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 stude	nts are able to:		
	 verificate the stability and usability of founda 	utions,		
	know individual methods of ground improvement and apply them in their range of application,			
	design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program): S	Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	General Engineering Science (German program, 7	semester): Specialisation Civil Engineering: Elective	Compulsory	
	Civil- and Environmental Engineering: Core qualific	cation: Compulsory		
	General Engineering Science (English program): S	pecialisation Civil- and Enviromental Engeneering: C	ompulsory	
	General Engineering Science (English program, 7	semester): Specialisation Civil Engineering: Elective C	Compulsory	

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

Course L0553: Foundation Engineering	
Тур	Recitation Section (large)
Hrs/wk	2
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 Er	gineering			
Courses				
Title		Тур	Hrs/wk	СР
Wastewater Disposal (L0276)		Lecture	2	2
Wastewater Disposal (L0278)		Recitation Section (large)	1	1
Drinking Water Supply (L0306)		Lecture	2	1
Drinking Water Supply (L0308)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	none			
Recommended Previous	Book knowledge on Chemistry and Biology			
Knowledge	Basic knowledge on Chemistry and Biology Hydraulics of pipe systems and open channels			
	Basic knowledge on water management: water quantity and water	quality		
	Basic knowledge on Environmental Legislation: Federal Water Act			
	Basic knowledge on Environmental Legislation. Federal Water Act			
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastr	ructures. They can present the derivati	on and detailed	explanation of important
	standards for the design of drinking water supply and wastewater disp	osal systems in Germany and they a	are capable of r	reproducing the relevant
	empiricals assumptions and scientific simplifications. The students are able	e to present and discuss sanitary engi	ineering process	ses and the technologies
	used for drinking and wastewater treatment. They can also assess existing	ng problems in the field of sanitary en	gineering by co	nsidering legal, risk and
	saftey aspects. Furthermore, they know how to draft the features and e	ffectiveness of important technologic	es of the future	such as high- and low-
	pressure membrane filtration systems and techniques for the removal of tra	ace 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 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 duration and scale	Written exam			
Examination duration and scale	120 min	1 Environmental Engancering Community	20n/	
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and			
Curricula	General Engineering Science (German program, 7 semester): Specialisati	on Givii Engineering: Elective Compul	isory	
	Civil- and Environmental Engineering: Core qualification: Compulsory	Environmental Engagemental Communication	071	
	General Engineering Science (English program): Specialisation Civil- and		•	
	General Engineering Science (English program, 7 semester): Specialisation	on Givii Engineering: Elective Compul	sory	



Course L0276: Wastewater Disposa	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	This lecture focusses on urban drainage and wastewater treatment.
	Urban Drainage Design of urban drainage systems (combined and separate sewer systems) Special structures
	Rainwater management Wastewater treatement
	 Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration) Biological Treatment (aerobic, anaerobic, anoxic) Special Wastewater Treatment Processes (Ozonation, Adsorption)
Literature	Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.
	The literature listed below is available in the library of the TUHH.
	 Taschenbuch der Stadtentwässerung: mit 10 Tafeln und 67 Tabellen, Imhoff, K., & . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl. Abwasser: Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998. Kommunale Kläranlagen: Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Gunthert, F. Wolfgang: (3., vollig neu bearb. Aufl.). Renningen: expert-Verl. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering: design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course L0278: Wastewater Disposal	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

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



Module M0869: Hydraulic E	ingineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L0959)		Lecture	2	2
Hydraulic Engineering (L0960)		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Hydraulik Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached to	he following learning results		
Professional Competence				
Knowledge	Students are able to define the basic terms of hydra	ulic engineering and hydraulics. They are able to	explain the application	on of basic hydrodynami
	formulations (conservation laws) to practical hydrau	lic engineering problems. Besides this, the stude	ents can illustrate imp	ortant tasks of hydrauli
	engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.			
0				
Skills	The students are able to apply 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 conditions of pipe system.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionally, they will be able to work in team with engineers of other			
	disciplines.			
Autonomy	The students will be able to independently extend their	r knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding of the lecture contents and			
	calculations tasks.			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	General Engineering Science (German program, 7 set	* *		
	Civil- and Environmental Engineering: Core qualificati	on: Compulsory		
	General Engineering Science (English program): Spec	cialisation Civil- and Enviromental Engeneering: Co	ompulsory	
	General Engineering Science (English program, 7 sen	nester): Specialisation Civil Engineering: Elective C	ompulsory	

Course L0957: Hydraulics	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
	Flow of incompressible fluids in pipes and open channels Hydraulics of pipes Punps in hydraulic systems Open channel flow Regulative construction in open channel flow Weirs Sliding panels Cross-section reduction by constructions
Literature	Zanke, Ulrich C., Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003 Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

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



Course L0959: Hydraulic Engineering				
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Peter Fröhle			
Language	DE			
Cycle	SoSe			
Content	Fundamentals of hydraulic engineering			
	Introduction and hydrological cycle River engineering Regime theory of natural rivers Sediment transport Regulation of rivers Bank protection / protection of river bed Tidal rivers Flood protection Dikes Flood contraol basins Hydraulic power Inland waterways engineering waterways Locks and ship lifts Fish passages Nature-oriented hydraulic engineering			
Literature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006			
	Patt, H. & Gonsowski, P: Wasserbau, Springer 2011			

Course L0960: Hydraulic 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 CO₂ 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 CO₂ emissions by increasing efficiency and by capturing the CO₂ 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 M0596. Mechanica	r Engliteering. Design						
Courses							
Title		Тур	Hrs/wk	CP			
Embodiment Design and 3D-CAD (L0268)		Lecture	2	1			
Mechanical Design Project I (L0695)		Practical Course	3	2			
Mechanical Design Project II (L0592) Team Project Design Methodology (L0267)	7)	Practical Course Problem-based Learning	3 2	2			
Module Responsible	Prof. Dieter Krause	Troblem based Eddming					
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	learning results					
Professional Competence							
Knowledge	After passing the module, students are able to:						
	explain design guidelines for machinery parts e.g. conside	ring load situation, materials and manu-	facturing requirements				
	describe basics of 3D CAD,		9 - 4	,			
	 explain basics methods of engineering designing. 						
01.71	Affective the good to students as able to						
SKIIIS	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. 						
Personal Competence							
Social Competence	After passing the module, students are able to:						
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, 						
	present and discuss solutions and technical drawings withing.	n groupe					
	reflect the own results in the work groups of the course.						
Autonomy	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. 						
Wester de la Herre	Indiana day Orda Tara 40 Orda Tara in Last and 40						
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140						
Credit points Examination	6 Written exam						
Examination duration and scale	180						
Assignment for the Following	General Engineering Science (German program): Specialisation E	nergy and Environmental Engineering:	Compulsory				
Curricula	General Engineering Science (German program): Specialisation I	0,					
	General Engineering Science (German program): Specialisation E						
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory						
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory						
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory						
	Energy and Environmental Engineering: Core qualification: Compulsory						
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory						
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory						
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory						
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory						
	General Engineering Science (English program, 7 semester): Spe						
	General Engineering Science (English program, 7 semester): Spe	cialisation Energy and Enviromental En	igineering: Compulsor	<i>y</i>			
	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			
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	WiSe		
Content	Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings		
Literature	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. 		

Course L0695: Mechanical Design F	course L0695: Mechanical Design Project I		
Тур	Practical Course		
Hrs/wk	3		
СР	2		
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42		
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	WiSe		
Content	Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet		
Literature	 Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. 		



Course L0592: Mechanical Design Project II		
Тур	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	 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 	



nodale Mossi. Introduction	n into Energy and Environmental Er			
Courses				
itle		Тур	Hrs/wk	СР
ntroduction to Energy and Environmental	Engineering (L0212)	Problem-based Learning	4	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 reac	hed the following learning results		
Professional Competence				
Knowledge	The students can sketch the different options for	electricity and heat generation and gain insight into en	vironmental engineeri	ng technologies. They a
	able to present and discuss the technical and e	environmental engineering advantages and disadvant	ages (balancing act be	etween affordable ene
	usage and minimisation of environmental impac	t) of the different alternatives on a basic level. The stu	dents are aware of the	dimension of their fut
	responsibility and know about the necessity to fin	d compromises between energy generation and enviro	nment protection.	
	Through a practical course in physics the student	ts learn to deliver an overview of certain relevant aspec	ts of physics	
	Through a practical course in physics are staden	a learn to deliver all everylew of certain relevant aspec	is of physics.	
Skills	The students master the fundamentals of techr	nical communication. They are able to explain specia	lised topics orally. By	a comparing analysis
	literature sources, students are able to work scien	ntifically and to critically discuss them on a basic level.		
	The students are able to communicate their deep	ened physics knowledge in written technical communic	ation.	
Personal Competence				
Social Competence	The social skills of the students are strengthene	d by working in a group as well as visiting a company.	For the preparation of	the seminar presentat
coolai competence	the students gain communication skills.	a by working in a group as well as visiting a company.	Tor the proparation of	the seminal presentati
	the stadents gam communication skins.			
	The practical course in Physics is also carried of	out in groups, including the preparation of the test rep	orts. The students stre	ngthen further their soc
	skills, can achieve common results in a group an	d report those results in joint test protocols.		
A		was the section of the second section of the section of	da a ta a una a la la ta consulo.	
Autonomy		rmulate realistically conclusions on their own. The stud	denis are able to Work	muepenaemily on spec
	technical subjects and to present these to the gro	up.		
	The students are able to familiarise themselves w	vith experimental demonstrations and individually prepa	are and present a short	experimental report.
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6			
Examination	Presentation			
Examination duration and scale		s 1 p Handout; Physics Lab: error calculation seminar	•	ntrod. seminar (20 min
		n their own and attestation; 10min short presentation a		
Assignment for the Following	General Engineering Science (German program)	: Specialisation Energy and Environmental Engineering:	Compulsory	
Curricula	Energy and Environmental Engineering: Core qu	alification: Compulsory		
	General Engineering Science (English program)	: Specialisation Energy and Environmental Engineering:	Compulsory	

Course L0212: Introduction to Energ	gy and Environmental Engineering		
Тур	Problem-based Learning		
Hrs/wk	4		
CP	3		
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56		
Lecturer	Prof. Alfons Kather		
Language	DE		
Cycle	WiSe		
Content	The course is made up of three components: Lectures by invited speakers, excursions and talks by the students. The lectures by invited speakers are		
	connected to the companies 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 example 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		
	Energy management at end-user level		
	Energy-intensive industries		
	Environmental technology (e.g., wastewater treatment plants)		
Literature	Keine erforderlich		



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



Module M0536: Fundament	als of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (L0091)		Lecture	2	4
Fluid Mechanics for Process Engineering	(L0092)	Recitation Section (large)	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I+II+III			
Knowledge	 Technical Mechanics I+II 			
	Technical Thermodynamics I+II			
	Working with force balances Circultant and onlying of partial differential a			
	 Simplification and solving of partial differential en Integration 	qualions		
Educational Objectives	-	fellowing language was also		
Educational Objectives Professional Competence	After taking part successfully, students have reached the	e following learning results		
Knowledge	Students are able to:			
		_		
	explain the difference between different types of different applications of the		ring	
	give an overview for different applications of the explain simplifications of the Continuity- and Nav	Reynolds Transport-Theorem in process enginee vier-Stokes-Equation by using physical boundary		
		nor closed Equation by doing physical boundary		
Skills	The students are able to			
	 describe and model incompressible flows mathe 	matically		
	reduce the governing equations of fluid mechanics.		ons e.g. by integration	
	notice the dependency between theory and tech			
	 use the learned basics for fluid dynamical applic 	ations in lields of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from subject re	elated, professional publications and relate that in	formation to the contex	t of the lecture and
	able to work together on subject related tasks in	small groups. They are able to present their result	Its effectively in English	n (e.g. during small gro
	exercises)			
	 are able to work out solutions for exercises by th 	emselves, 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 exp 	and their knowledge with this literature,		
	work on their exercises by their own and to evaluate			
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): Speci			
Curricula	General Engineering Science (German program): Speci		2	
	General Engineering Science (German program): Speci General Engineering Science (German program, 7 sem	• • • • • • • • • • • • • • • • • • • •		
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem	, ,		ry
	Bioprocess Engineering: Core qualification: Compulsor	y		
	Energy and Environmental Engineering: Core qualificat			
	General Engineering Science (English program): Speci			
	General Engineering Science (English program): Specia		Compulsory	
	General Engineering Science (English program): Special General Engineering Science (English program, 7 seme		ulsorv	
	General Engineering Science (English program, 7 seme			
	General Engineering Science (English program, 7 seme	, ,		у
	Technomathematics: Specialisation III. Engineering Scientific Scie			
	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	 fluid properties hydrostatic overall balances - theory of streamline overall balances - conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

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



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	NN			
Admission Requirements	none			
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals, or	lifferentials		
Knowledge	Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence		<u> </u>		
Knowledge	Students can to draw and explain the basic principles of electric ar	d magnetic fields.		
	They can describe the function of the standard types of electric	machines and present the correspor	nding equations and cl	haracteristic curves. For
	typically used drives they can explain the major parameters of the e	nergy efficiency of the whole system f	rom the power grid to th	e driven engine.
Skills	Students arw able to calculate two-dimensional electric and magne	etic fields in particular ferromagnetic c	ircuits with air gap. For	this they apply the usual
	methods of the design auf electric machines.	,	0 1	, ,,,
	They can calulate the operational performance of electric machines	from their given characteristic data a	nd selected quantities a	nd characteristic curves
	They apply the usual equivalent circuits and graphical methods.			
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate electric and magna	atic fields for applications. They are	able to analyse indepe	endently the operational
	performance of electric machines from the charactersitic data and the	neycan calculate thereof selected quar	ntities and characteristic	curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation El	nergy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation M	echanical Engineering: Elective Comp	oulsory	
	General Engineering Science (German program, 7 semester): Spec		•	/
	General Engineering Science (German program, 7 semester): Spec	**		
	Electrical Engineering: Core qualification: Elective Compulsory	S S		
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En		Compulsory	
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec			
	Computational Science and Engineering: Specialisation Engineeri		. ,	
	Logistics and Mobility: Specialisation Engineering Science: Elective			
	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	NN
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	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	NN	
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			
modulo modificino non della sici	and Energy Cyclems			
Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Industry (L03	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 reach	ed the following learning results		
Professional Competence				
Knowledge	With completion of this module, the students can	n provide an overview of characteristics of energy sy	stems and their econo	mic efficiency. They can
	explain the issues occurring in this context. Further	ermore, they can explain details of power generation, p	ower distribution and p	power trading wih regard
	to subject-related contexts. The students can expl	lain these aspects, which are applicable to many energiate	gy systems in general,	especially for renewable
	energy systems and critical discuss them. Furthern	more, the students can explain the environmental bene	fits from the use of such	systems.
Skilla	Students are able to apply methodologics for d	stailed determination of anaray demand or anaray a	raduation for various t	upon of operate avetoms
Skills	Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design them under certain given conditions.			
				certain given conditions
	Therefore, they can choose the necessary subject	s-specific calculation rules, also for not standardized sol	utions of a problem.	
	The students are able to explain questions and p	ossible approaches to its processing from the field of r	enewable energies ora	ally and to put them ther
	into the right context.	occione approaches to no processing nem are note or .	one waste one groot or	any and to par arom aron
	The tre right context.			
Personal Competence				
Social Competence	The students are able to analyze suitable tec	hnical alternatives and to assess them with technic	cal, economical and e	ecological criteria unde
	sustainability aspects. This allows them to make a	n effective contribuition to a more sustainable power su	pply.	
Autonomy	Students can independently exploit sources, acqu	uire the particular knowledge about the subject area an	d transform it to new qu	estions.
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
		0	0 1	
Assignment for the Following		Specialisation Energy and Environmental Engineering:		
Curricula		7 semester): Specialisation Energy and Enviromental E		•
		7 semester): Specialisation Mechanical Engineering, Fo	ocus Energy Systems: I	Elective Compulsory
	Energy and Environmental Engineering: Core qua	alification: Compulsory		
	General Engineering Science (English program):	Specialisation Energy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program, 7	semester): Specialisation Energy and Enviromental En	ngineering: Compulsor	у
	General Engineering Science (English program, 7	semester): Specialisation Mechanical Engineering, Fo	cus Energy Systems: E	lective Compulsory

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



Course L0315: Energy 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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students
1 throaten	and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007



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	Toblem-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 re	esults		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different Marketing and Innovation, and also to Investment and Controlling. In particular		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management and the	e sub-disciplines in Managem	nent and to name impo	ortant definitions from t
	field of Management	and the second second second		
	 explain the most important aspects of and goals in Management and describe and explain basic business functions as production, procu 			
	ressource management, information management, innovation management		chair management,	ngamzation and num
	explain the relevance of planning and decision making in Business		Iltiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected controlling me	thods.		
Skills	Students are able to analyse business units with respect to different Entrepreneurship project in a team. In particular, they are able to	criteria (organization, object	ctives, strategies etc) and to carry out
	analyse Management goals and structure them appropriately			
	analyse management goals and structure trem appropriately analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives, under under the decision making under multiple objectives.	incertainty and under risk		
	analyse production and procurement systems and Business informati			
	analyse and apply basic methods of marketing			
	select and apply basic methods from mathematical finance to predefin	ned problems		
	apply basic methods from accounting, costing and controlling to prede	efined 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 projection.	ect and write a coherent repor	t on the project	
	to communicate appropriately and			
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering	ngineering: Compulsory		
Curricula				
	General Engineering Science (German program): Specialisation Process Eng			
	General Engineering Science (German program): Specialisation Bioprocess General Engineering Science (German program): Specialisation Energy and		omnulsory	
	General Engineering Science (German program): Specialisation Civil- and E			
	General Engineering Science (German program): Specialisation Mechanical		, ,	
	General Engineering Science (German program): Specialisation Biomedical	Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Naval Archi	tecture: Compulsory		
	General Engineering Science (German program, 7 semester): 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			
	General Engineering Science (German program, 7 semester): 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	Energy and Environmental En	gineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation		-	
	General Engineering Science (German program, 7 semester): Specialisa Compulsory	won weonanical Engineering	y, rocus iviateriais In	Lingingering Science
	General Engineering Science (German program, 7 semester): Specialisat	tion Mechanical Engineering	, Focus Theoretical M	Mechanical Engineeri
	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			



Compulsory

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

inpulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



se 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. Wolfgat
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Manageme 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
Literature	Important aspects of Entrepreneurship projects 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	Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Ann-Isabell Hnida, Hamed Farhadian, Katharina Roedelius, Oliver Welling, Maximilian Muelke	
Language	DE	
Cycle	WiSe/SoSe	
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,	
	using their knowledge from the corresponding lecture.	
	Project work is carried out in teams with the support of a mentor.	
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.	



Module M0538: Heat and N	lass Transfer			
Courses				
Title		Tun	Hrs/wk	CP
Heat and Mass Transfer (L0101)		Typ Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
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	he following learning results		
Professional Competence				
Knowledge	The students are capable of explaining quality chemical reactors). They are capable of distinguish and characterizadiation. The students have the ability to explain the physicing suitable mass transfer theories.	tative and determining quantitative heat transfer in ize different kinds of heat transfer mechanisms name special basis for mass transfer in detail and to describe eat- and mass transfer and to describe complex links	nely heat conduction, h	eat transfer and thermal
Skills	The students are able to set reasonable syste corresponding energy and mass flow, respective They are capable to solve specific heat transf corresponding heat flows. Using dimensionless quantities, the students capable to distinguish between diffusion and design of apparatus (e.g. extraction columns.) In this context, the students are capable to considering their advantages and disadvantage. In addition, they can calculate both, steady-statt.	an execute scaling up of technical processes or app n, convective mass transition and mass transfer. Th n, rectification column). choose and design fundamental types of heat ar	rature alteration in flu aratus. ey can use this know and mass exchanger for paratus. de of other courses (I	edge for the description
Personal Competence Social Competence				
Autonomy	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes. 			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	6		
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): Spe	cialisation Process Engineering: Compulsory		
Curricula				
	General Engineering Science (German program): Spe	**		
	General Engineering Science (German program, 7 ser	, ,	•	
	General Engineering Science (German program, 7 ser			,
	General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso		gineering: Compulsor	у
	Energy and Environmental Engineering: Core qualification:			
	General Engineering Science (English program): Spec			
	General Engineering Gelende (English program). Open		ompulsory	
	General Engineering Science (English program): Spec		- 11	
	General Engineering Science (English program): Spec	cialisation Process Engineering: Compulsory		
	General Engineering Science (English program): Spec		ılsory	
		nester): Specialisation Process Engineering: Compu		
	General Engineering Science (English program): Spec General Engineering Science (English program, 7 sen	nester): Specialisation Process Engineering: Compunester): Specialisation Bioprocess Engineering: Cor	npulsory	,
	General Engineering Science (English program): Spec General Engineering Science (English program, 7 sen General Engineering Science (English program, 7 sen	nester): Specialisation Process Engineering: Compunester): Specialisation Bioprocess Engineering: Cornester): Specialisation Energy and Enviromental En	npulsory	,
	General Engineering Science (English program): Spec General Engineering Science (English program, 7 sen General Engineering Science (English program, 7 sen General Engineering Science (English program, 7 sen	nester): Specialisation Process Engineering: Compunester): Specialisation Bioprocess Engineering: Connester): Specialisation Energy and Enviromental Encience: Elective Compulsory	npulsory	,



Course L0101: Heat and Mass Transfer	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas

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

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



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	2	2
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge				
	The students can distinguish and describe different types of			
	The students develop an understanding for the course of course.		ss, the estimation of	the energy demand o
	process, the possibilities of energy saving, and the selection			
	They have good knowledge of designing methods for separate.	ation processes and devices		
Skills	Using the gained knowledge the students can select a reasc	anable system boundary for a given sen	aration process and	can close the associat
	energy and material balances	madic dystem boundary for a given sep	aration process and	oan ologe the aggoria
		igning of a concretion process and defi	no the emount of the	aratical atagaa raguira
	The students can use different graphical methods for the des			
	They can select and design a basic type of thermal separation	ation process for a given case based (on the advantages a	nd disadvantages of
	process			
	The students are capable to obtain independently the needed.		sources (diagrams ar	d tables)
	They can calculate continuous and discontinuous processes			
	The students are able to prove their theoretical knowledge in the experimental lab work.			
	The students are able to discuss the theoretical background	and the content of the experimental wo	rk with the teachers in	colloquium.
	The students are concluded linking their gained knowledge with the content of other lectures and the other factor of the selection of the sele			
	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.			
	Other lectures such as thermodynamics, fluid mechanics and chemical engineering.			
Personal Competence				
Social Competence	The students can work technical assignments in small group	s and present the combined results in the	ne tutorial	
	- The stadents can work technical assignments in small group	s and present the combined results in t	io tatoriai	
	The students are able to carry out practical lab work in sma	Il groups and organize a functional divi	sion of labor batwas	n tham. Thay are able
			Sion of labor betwee	ii tilelli. Tiley ale able
	discuss their results and to document them scientifically in a	report.		
Autonomy				
,	The students are capable to obtain the needed information for the students are capable to obtain the needed information for the students are capable to obtain the needed information for the students are capable to obtain the needed information for the students are capable to obtain the needed information for the students are capable to obtain the needed information for the students.	om suitable sources by themselves and	d assess their quality	
	The students can proof the state of their knowledge with example.	m resembling assignments and in this w	ay control their learn	ing process
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination				
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation Pro			
Curricula	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program): Specialisation En			
	General Engineering Science (German program, 7 semester): Spec	ialisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Energy and Enviromental Eng	ineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compul	sory		
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program): Specialisation Eng		mpulsory	
	5 5 1 (·5····· p···· 5·····/, -p·····		, ,	
	General Engineering Science (English program): Specialisation Pro			
	General Engineering Science (English program 7 semester): Specialisation Pro		sorv	
	General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compul	-	
	General Engineering Science (English program, 7 semester): Speci General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compul alisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compul alisation Bioprocess Engineering: Com	pulsory	,



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



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



Course L0141: Thermal 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	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie



Course L1159: Separation Processe	es		
Тур	Laboratory Course		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Course work	Compulsory attendence of the colloquia of all experiments and compulsory report.		
Lecturer	Prof. Irina Smirnova		
Language	DE/EN		
Cycle	SoSe		
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the		
	students explain and discuss the theoretical background and its translation into practice with staff and fellow students.		
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in		
	terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.		
	Topics of the practical course:		
	Introduction in the thermal process engineering and to the main features of separation processes		
	Simple equilibrium processes, several steps processes		
	Distillation of binary mixtures, enthalpy-concentration diagrams		
	Extractive and azeotrope distillation, water vapor distillation, stepwise distillation		
	Extraction: separation ternary systems, ternary diagram		
	Multiphase separation including complex mixtures		
	Designing of separation devices without discrete stages		
	• Drying		
	Chromatographic separation processes		
	Membrane separation		
	Energy demand of separation processes		
	Advance overview of separation processes		
	Selection of separation processes		
Literature			
	G. Brunner: Skriptum Thermische Verfahrenstechnik		
	J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980		
	Sattler: Thermische Trennverfahren, VCH, Weinheim 1995		
	J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.		
	Mersmann: Thermische Verfahrenstechnik, Springer, 1980		
	Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997		
	Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Provided Services No. 2014, 1990 1990 1990 1990 1990 1990 1990 199		
	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 For Allon String Str		
	Enzyklopädie der Technischen Chemie		



Module M0956: Measureme	ent Technology for Mechanical and Proces	ss 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 eng	ineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundment	als 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	for different kinds of quantities to be massured (Flectrical Quantities	Temperature mechanica
	quantities, Flow, Time, Frequency).	To different kinds of qualitates to be indesured (Licotioai Quarititico,	remperature, meditamea
	quantities, Flow, Filic, Frequency).			
	They can describe important methods of chemical Analys	sis (Gas Sensors, Spectroscopy, Gas Chromatogr	aphy)	
Skills	Students can select suitable measuring methods to giver	problems and can use refering measurement de	evices in practice.	
	The students are able to evall, analysis issues in the cube			
	The students are able to orally explain issues in the sub	ject area of measurement technology and solution	on approaches as wei	i as piace the issues into
	the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and docume	ent them in a common report.		
Autonomy	Students are able to familiarize themselves with new mea	asurement technologies.		
Wester de Herre	Industrial Old Trackle Old Trackle Industrial			
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): Specia		Compulsory	
Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia		ainooring, O	
	General Engineering Science (German program, 7 seme	, , , , , , , , , , , , , , , , , , ,		у
	General Engineering Science (German program, 7 seme	, ,		
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme			
	Energy and Environmental Engineering: Core qualification		uisoly	
	General Engineering Science (English program): Specia	' '	omnulsory	
	General Engineering Science (English program): Specia	**	отпривоту	
	General Engineering Science (English program): Specia	0 0 1 7		
	General Engineering Science (English program): Specia			
	General Engineering Science (English program, 7 semes		gineering: Compulsor	V
	General Engineering Science (English program, 7 semes	, ,		,
	General Engineering Science (English program, 7 semes	, ,		
	General Engineering Science (English program, 7 semes			
	Mechanical Engineering: Core qualification: Compulsory		,	
	Mechatronics: Core qualification: Compulsory			



Hrs/wk	Laboratory Course
	2
	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Wolfgang Schröder
. 33.	DE
Cycle	WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftlich Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münche Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1 Versuch 2:
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze
	Versuch 3:
	 Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989
	Versuch 4:
	 Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen



Course L1116: Measurement Techn	nology for Mechanical and Process Engineers	
Тур		
Hrs/wk		
CP Workload in Hours	3 Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	1 Fundamentals	
	1.1 Quantities and Units	
	1.2 Uncertainty	
	1.3 Calibration	
	1.4 Static and Dynamic Properties of Sensors and Systems	
	2 Measurement of Electrical Quantities	
	2.1 Current and Voltage	
	2.2 Impedance	
	2.3 Amplification	
	2.4 Oscilloscope	
	2.5 Analog-to-Digital Conversion	
	2.6 Data Transmission	
	3 Measurement of Nonelectric Quantities	
	3.1 Temperature	
	3.2 Length, Displacement, Angle	
	3.3 Strain, Force, Pressure	
	3.4 Flow	
	3.5 Time, Frequency	
	4 Chemical Analysis	
	4.1 Gas Sensors	
	4.2 Spectroscopy	
	4.3 Gas Chromatography	
	At the end of each lecture students present single measuring techniques and results orally in front of the class.	
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.	
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.	

Course L1118: Measurement Technology for Mechanical and Process Engineers	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Sven Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title		Тур	Hrs/wk	СР
Gas and Steam Power Plants (L0206)		Lecture	3	4
Gas and Steam Power Plants (L0210)	T	Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous	The decided The consideration of the design			
Knowledge	 "Technical Thermodynamics I and II" "Heat Transfer" 			
	"Fluid Mechanics"			
Educational Objectives	After taking part successfully, students have reach	hed the following learning results		
Professional Competence				
Knowledge	· ·	e electricity demand and the energy conversion route		
		m generator block. They are also able to determine		
	Additionally they can describe the exhaust gas solar thermal and geothermal power plants or pla	cleaning apparatus and the combination possibilities ants equipped with Carbon Capture and Storage.	s of conventional fossil-	fuelled power plants
	The students have basic knowledge about the pri	inciples, operation and design of turbomachinery		
Skills	The students will be able, using theories and me	thods of the energy technology from fossil fuels and b	ased on well-founded k	nowledge on the fun
		s, to identify basic associations in the production of I		
	solutions. Through analysis of the problem and e	exposure to the inherent interplay between heat and	power generation the st	udents are endowed
	the capability and methodology to develop realist	tic optimal concepts for the generation of electricity and	I the production of heat.	From the technical ba
	the students become the ability to follow better the deliberations on the electricity mix composition within the energy-political triangle (economy, s			
	supply and environmental protection).			
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With this tool small protection tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.			th this tool small prac
	The students are able to do simplified calculations on turbomachinery either as part of a plant, as single component or at stage level.			level.
	· ·		,	
Personal Competence	As a constant of the form of the last of t	to the condition of the state of the state of The state of		
Social Competence		is planned for students that are interested. The studen	-	
	technical and political issues.	ain first-hand experience with a power plant in opera	tion and gain insigns	into the confincts betw
Autonomy	·	to develop alone simple simulation models and run	with these scenario and	alvses In this manne
natonomy	· ·	·		•
	theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations a conditions highlighted. The students are able independently to analyse the operational performance of steam power plants and calcu			
	quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	Written examination of 120 min			
Assignment for the Following		: Specialisation Energy and Enviromental Engineering		
Curricula		: Specialisation Mechanical Engineering, Focus Energ		
		7 semester): Specialisation Energy and Environmental		-
		7 semester): Specialisation Mechanical Engineering,	Focus Energy Systems:	Elective Compulsory
	Energy and Environmental Engineering: Core qui	alification: Compulsory Specialisation Energy and Enviromental Engineering	Compulsory	
		Specialisation Energy and Environmental Engineering Specialisation Mechanical Engineering, Focus Energ		
		7 semester): Specialisation Energy and Enviromental		rv
	General Engineering Science (English program.)	7 semester): Specialisation Mechanical Engineering, F	ocus Energy Systems: I	Elective Compulsory



Course L0206: Gas and Steam Pow	er Plants
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
	Electricity demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in thermal power plants
	Types of power plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials for power plants
	Location of power plants
	Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.
	These are complemented in the 2 nd part of the module by the more specialised issues:
	Energy balance of a turbomachine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic turbomachines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems.
Literature	a Valida Vraft und Arbeitamaschinen
	Kalide: Kraft- und Arbeitsmaschinen Thomas H. I. Thomasche Kraftralagen, Springer Verlag, 1995
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß K.: Kraftwarksteehnik. Springer, Verlag, 2006.
	 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
	 Rugeler und Prilippen: Energielecrinik. Springer-verlag, 1990 Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer
	 Bonn, I. (Hrsg.): Handbuchreine Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Helzkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland
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se L0210: Gas and Steam Pow	or riants
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	
	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus 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 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 afterw
	ask questions and get feedback. The course work has a positive effect on the students final grade.
	and got house and got houseast. The course work has a positive circuit of the states in the states in the states.
Literature	0.00
	Skripte Kalida Kaff and Arbeitanaching
	Kalide: Kraft- und Arbeitsmaschinen There a. H. I. Thereigh L. Krafterlesse Cariners Value 1995.
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Change K. Kraftandasta hall Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Daha (March March and Archael and
	T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis
	Verlag Resch / Verlag TÜV Rheinland



Module M0933: Fundamen	tals of Materials Science			
	- Indicate Science			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Materials Science I (L1085)		Lecture	2	2
rundamentals of Materials Science II (Adv Physical and Chemical Basics of Materials	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2
	Prof. Jörg Weißmüller	Lecture	2	2
-	*			
Admission Requirements Recommended Previous	None			
Knowledge	Highschool-level physics, chemistry und mathematics			
Kilowiedge				
Educational Objectives	After taking part cureoccefully, at idente have reached the following	Loarning recults		
	After taking part successfully, students have reached the following	rearring results		
Professional Competence	The students have acquired a fundamental knowledge on m	atala agramica and nalumara a	and can describe this know	dadaa aamarahansiy
Knowledge	The students have acquired a fundamental knowledge on m Fundamental knowledge here means specifically the issues of a			
	mechanical properties. The students know about the key aspec			
	characterizing specific properties. They are able to trace materials			
		, , , , , , , , , , , , , , , , , , , ,	.9 p.,,	
Skills	The students are able to trace materials phenomena back to the	underlying physical and chemica	I laws of nature. Materials p	henomena here refers
	mechanical properties such as strength, ductility, and stiffness, cl			
	solidification, precipitation, or melting. The students can explain		conditions and the materials	microstructure, and t
	can account for the impact of microstructure on the material's beh	avior.		
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			
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compuls	sory	
	General Engineering Science (German program): Specialisation		ory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp	ecialisation Biomedical Engineerir	ng: Compulsory	
		*		
	General Engineering Science (German program, 7 semester): Sp	ecialisation Naval Architecture: Co		
	General Engineering Science (German program, 7 semester): Sp	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen		у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen oulsory	ntal Engineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen oulsory Energy and Enviromental Engineer	ntal Engineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulsa	ntal Engineering: Compulsor ring: Compulsory ory	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation E	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulso	ntal Engineering: Compulsor ring: Compulsory ory	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation N	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory	ntal Engineering: Compulsor ring: Compulsory ory	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation M General Engineering Science (English program, 7 semester): Specialisation M	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory ecialisation Mechanical Engineering	ntal Engineering: Compulsor ring: Compulsory ory ory ng: Compulsory	у
	General Engineering Science (German program, 7 semester): Sp Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation In General Engineering Science (English program): Specialisation In General Engineering Science (English program): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program, 7 semester): Specialisation In General Engineering Science (English program)	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory ecialisation Mechanical Engineerin ecialisation Biomedical Engineerin	ntal Engineering: Compulsor ring: Compulsory ory ng: Compulsory g: Compulsory	у
	General Engineering Science (German program, 7 semester): Spe Energy and Environmental Engineering: Core qualification: Comp General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program, 7 semester): Specialisation E General Engineering Science (English program, 7 semester): Specialisation E General Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program)	ecialisation Naval Architecture: Co ecialisation Energy and Enviromen bulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulso Javal Architecture: Compulsory ecialisation Mechanical Engineerin ecialisation Biomedical Engineerin ecialisation Naval Architecture: Con	ntal Engineering: Compulsor ring: Compulsory ory ng: Compulsory g: Compulsory mpulsory mpulsory	
	General Engineering Science (German program, 7 semester): Spenergy and Environmental Engineering: Core qualification: Companeral Engineering Science (English program): Specialisation Egeneral Engineering Science (English program): Specialisation Magneral Engineering Science (English program): Specialisation Egeneral Engineering Science (English program): Specialisation Magneral Engineering Science (English program, 7 semester): Specialisation Egeneral Engineering Science (English program, 7 semester): Specialisation Engineering Engine	ecialisation Naval Architecture: Co ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory Javal Architecture: Compulsory ecialisation Mechanical Engineerin ecialisation Biomedical Engineerin ecialisation Naval Architecture: Col ecialisation Energy and Enviromen	ntal Engineering: Compulsor ring: Compulsory ory ng: Compulsory g: Compulsory mpulsory mpulsory	
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	General Engineering Science (German program, 7 semester): Spenergy and Environmental Engineering: Core qualification: Companeral Engineering Science (English program): Specialisation Egeneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program, 7 semester): Specialisation Meneral Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science: Electi Mechanical Engineering: Core qualification: Compulsory	ecialisation Naval Architecture: Co ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory Javal Architecture: Compulsory ecialisation Mechanical Engineerin ecialisation Biomedical Engineerin ecialisation Naval Architecture: Col ecialisation Energy and Enviromen	ntal Engineering: Compulsor ring: Compulsory ory ng: Compulsory g: Compulsory mpulsory mpulsory	
	General Engineering Science (German program, 7 semester): Spenergy and Environmental Engineering: Core qualification: Companeral Engineering Science (English program): Specialisation Egeneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program): Specialisation Meneral Engineering Science (English program, 7 semester): Specialisation Meneral Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science: Electives and Mobility: Specialisation Engineering Science: Electives	ecialisation Naval Architecture: Co ecialisation Energy and Enviroment pulsory Energy and Enviromental Engineer Mechanical Engineering: Compulso Biomedical Engineering: Compulsory Javal Architecture: Compulsory ecialisation Mechanical Engineerin ecialisation Biomedical Engineerin ecialisation Naval Architecture: Col ecialisation Energy and Enviromen	ntal Engineering: Compulsor ring: Compulsory ory ng: Compulsory g: Compulsory mpulsory mpulsory	

Course L1085: Fundamentals of Materials Science I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jörg Weißmüller	
Language	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			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 following	learning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound k	knowledge of environmental technological	gy. 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.			
Chille	Ct. danta are able to arrange and action		blassa Thair are able to	
Skills	Students are able to propose appropriate management and mitigate parameters and to assess the potential of pollutants to migrate	'	,	· ·
	Environmental Technology contributes to sustainable development			·
	Environmental reciniology contributes to sustamable development	i, and they can present and detend the	ese opinons in nont of a	id against the group.
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different			
	approaches to the task as a group as well as to discuss their theore	etical or practical implementation.		
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems.		i.	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisation E	nergy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation Program	rocess Engineering: Elective Compul-	sory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviromental E	Engineering: Compulsor	y
	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	ılsory		
	General Engineering Science (English program): Specialisation Er	nergy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program): Specialisation Pr	ocess Engineering: Elective Compuls	sory	
	General Engineering Science (English program, 7 semester): Spec	ialisation Energy and Enviromental E	ingineering: Compulsory	,
	General Engineering Science (English program, 7 semester): Spec	ialisation Process Engineering: Elect	ive Compulsory	
	General Engineering Science (English program, 7 semester): Spec	sialisation Bioprocess Engineering: El	ective 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 Ted	chnology and Solids Process Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L0434)		Lecture	2	3
Particle Technology I (L0435)		Recitation Section (small)	1	1
Particle Technology I (L0440)	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	earning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	 name and explain processes and unit-operations of solids p 	rocess engineering.		
	 characterize particles, particle distributions and to discuss th 			
Skills	Students are able to			
			: d = = = = = = =	
	 choose and design apparatuses and processes for solids pr asses solids with respect to their behavior in solids processing 	* *	ids properties of the pro	oduct
	document their work scientifically.	ig 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	Students are able to analyze and solve questions regarding solid pa	articles independently.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Program	ocess 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): Spec	alisation Process Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Spec	alisation Bioprocess Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester): Spec	alisation Energy and Enviromental E	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comput	sory		
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program): Specialisation En		Compulsory	
	General Engineering Science (English program): Specialisation Pro			
	General Engineering Science (English program, 7 semester): Speci		•	
	General Engineering Science (English program, 7 semester): Speci			
	General Engineering Science (English program, 7 semester): Speci	alisation Energy and Enviromental Er	ngineering: 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	Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

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

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



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				
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Knowledge	With the completion of this module the students acquire in-d	enth knowledge of important cause-effect ch	ains of notential enviro	nmental problems whi
Miowieuge	might occur from production processes, projects or construct			·
	in dealing with different methods and instruments to assess			
	environmental processes as well as uncertainties and difficu		its are able to estimate	the complexity of the
Skilla	· ·		at mathada. Tharaby th	av oon dovolon ovitok
Skills				
	solutions for managing and mitigating environmental prob independently and can apply the software programs OpenLC			
	to critically judge research results or other publications on er		g the course the stude	nts have the competen
	to critically judge research results of other publications off er	iviioninentai inipacis.		
Personal Competence				
Social Competence	The students are able to discuss the various technical and	scientific tasks, both subject-specific and mu	ultidisciplinary. They ar	re able to develop joir
	different solutions and to discuss their theoretical or practic	al implementation. Due to the selected lectu	re topics, the students	receive insights into
	multi-layered issues of the environment protection and the	concept of sustainability. Their sensitivity a	and consciousness tow	vards these subjects a
	raised and which helps to raise their awareness of their futur	e social responsibilities in their role as engin	eers.	
Autonomy	The students learn to research, process and present a scie	ntific topic independently. They are able to	carry out independent	scientific work. They ca
	solve an environmental problem in a business context and a	re able to judge results of other publications.		
	·			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Energy and Environmental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisa			
	General Engineering Science (German program, 7 semester			v
	General Engineering Science (German program, 7 semester			,
	General Engineering Science (German program, 7 semester			
	Bioprocess Engineering: Core qualification: Elective Compu			
	Energy and Environmental Engineering: Core qualification: (•		
	General Engineering Science (English program): Specialisa		Compulsory	
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semester)		•	/
			.gpaidoi	1
	General Engineering Science (English program 7 semester)): Specialisation Process Engineering: Flectiv	e Compulsory	
	General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester)			
	General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) Process Engineering: Core qualification: Elective Compulsor): Specialisation Bioprocess Engineering: Ele		



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

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



Specialization Biomedical Engineering

Module M0933: Fundament	als of Materials Science			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L108	35)	Lecture	2	2
Fundamentals of Materials Science II (Adv	anced 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 r	metals, ceramics and polymers an	d can describe this knowl	edge comprehensively.
	Fundamental knowledge here means specifically the issues of	atomic structure, microstructure, pha	se diagrams, phase transfo	rmations, corrosion and
	mechanical properties. The students know about the key aspe			
	characterizing specific properties. They are able to trace materia	Is phenomena back to the underlying	g physical and chemical law	s of nature.
Skills	The students are able to trace materials phenomena back to the	e underlying physical and chemical	laws of nature. Materials ph	enomena here refers to
	mechanical properties such as strength, ductility, and stiffness, of			
	solidification, precipitation, or melting. The students can explain			
	can account for the impact of microstructure on the material's bel	navior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Environmental Engineeri	ng: Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulso	ry	
	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	g: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Biomedical Engineering	g: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architecture: Con	npulsory	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Energy and Enviroment	al Engineering: Compulsory	1
	Energy and Environmental Engineering: Core qualification: Com	' '		
	General Engineering Science (English program): Specialisation	Energy and Environmental Engineering	ng: Compulsory	
	General Engineering Science (English program): Specialisation			
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	General Engineering Science (English program): Specialisation		0	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp		ai Engineering: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elec Mechanical Engineering: Core qualification: Compulsory	uve Compuisory		
	Mechatronics: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		
	100	Sale Sompaisory		



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

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

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



Module M0634: Introductio	n into Medical Technology and Systems			
Courses				
Title		Тур	Hrs/wk	CP
Introduction into Medical Technology and		Lecture	2	3
Introduction into Medical Technology and		Project Seminar	2	2
ntroduction into Medical Technology and		Recitation Section (large)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	none			
Recommended Previous	principles of math (algebra, analysis/calculus)			
Knowledge	principles of stochastics			
	principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students can explain principles of medical technol	ogy, including imaging systems, computer aided s	urgery, and medical ir	formation systems. The
	are able to give an overview of regulatory affairs and st	andards in medical technology.		
Skills	The students are able to evaluate systems and medical devices in the context of clinical applications.			
Personal Competence				
Social Competence	The students describe a problem in medical technology	y 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.			
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): Spec	cialisation Biomedical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 sem	nester): Specialisation Biomedical Engineering: Co	mpulsory	
	Computer Science: Specialisation Computer and Softw	rare Engineering: Elective Compulsory		
	Electrical Engineering: Core qualification: Elective Corr	npulsory		
	General Engineering Science (English program): Speci	ialisation Biomedical Engineering: Compulsory		
	General Engineering Science (English program, 7 sem	ester): Specialisation Biomedical Engineering: Cor	npulsory	
	Computational Science and Engineering: Specialisatio	n Engineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisatio	n Computer Science: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Organ	s and Regenerative Medicine: Elective Compulsory	/	
	Biomedical Engineering: Specialisation Implants and E	ndoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Techn	ology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management a	and Business Administration: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Sci	ence: Elective Compulsory		

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

Course L0343: Introduction into Medical Technology and Systems		
Тур	Project Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1876: Introduction into Medical Technology and Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	SoSe	
Content		
Literature		



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

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



Course L0455: Fluid 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



ourses				
itle		Тур	Hrs/wk	CP
gnals and Systems (L0432)		Lecture	3	4
ignals and Systems (L0433)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge			al burdha madula Mad	h il - 1 0 i
	The modul is an introduction to the theory of signals and systems. Goo Further experience with spectral transformations (Fourier series, Fourier			
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-in	variant (LTI) systems using metho	ods of signal and syste	em theory. They are a
	to apply the fundamental transformations of continuous-time and discrete	e-time signals and systems. They	can describe and anal	yse deterministic sign
	and systems mathematically in both time and image domain. In particular		in time domain and in	mage domain which
	caused by the transition of a continuous-time signal to a discrete-time sig	nal.		
Skills	The students are able to describe and analyse deterministic signals and			
	can analyse and design basic systems regarding important properties s		ponse, stability, linear	ity etc They can ass
	the impact of LTI systems on the signal properties in time and frequency of	domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.	Ph	and the state of the state	name a company
Autonomy	The students are able to acquire relevant information from appropriate	literature sources. They can cont	troi their level of know	riedge during the lec
	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 Electric			
Curricula	General Engineering Science (German program): Specialisation Comput			
	General Engineering Science (German program): Specialisation Process			
	General Engineering Science (German program): Specialisation Bioproc			
	General Engineering Science (German program): Specialisation Civil- ar General Engineering Science (German program): Specialisation Mechar		inpulsory	
	General Engineering Science (German program): Specialisation Mechanisms General Engineering Science (German program): Specialisation Biomed			
	General Engineering Science (German program, 7 semester): Specialisation		oulsory	
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa	·	-	
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			mpulsory
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa	ation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compuls
	General Engineering Science (German program, 7 semester): Specia	alisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisa	ation Mechanical Engineering, Foo	cus Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineering	, Focus Theoretical N	Mechanical Engineer
	Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- an		mpulsory	
	General Engineering Science (English program): Specialisation Bioproce			
	General Engineering Science (English program): Specialisation Electrica			
	General Engineering Science (English program): Specialisation Comput			
	General Engineering Science (English program): Specialisation Mechan			
	General Engineering Science (English program): Specialisation Biomedi General Engineering Science (English program): Specialisation Process			
	General Engineering Science (English program, 7 semester): Specialisation		uleon	
	General Engineering Science (English program, 7 semester): Specialisat		•	
	General Engineering Science (English program, 7 semester): Specialisation			
	General Engineering Science (English program, 7 semester): Specialisation			
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			mpulsory
	General Engineering Science (English program, 7 semester): Specialisat	-		
		-		
	General Engineering Science (English program, 7 semester): Specialisation	tion Mechanical Engineering, Foc	ao i moran o jotorno Er	ngineering: Compulso
	General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specialisa	alisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Special Compulsory General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	General Engineering Science (English program, 7 semester): Specialisat General Engineering Science (English program, 7 semester): Special Compulsory General Engineering Science (English program, 7 semester): Specialisat	alisation Mechanical Engineering tion Mechanical Engineering, Foc lisation Mechanical Engineering	g, Focus Materials in	Engineering Scien



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



	IV (Kinetics II, Oscillations, Analytical Mechar			
Courses				
Title		Тур	Hrs/wk	CP
	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in mechanical	contexts:		
	explain important steps in model design;			
	present technical knowledge.			
	,			
Skills	The students can			
	explain the important elements of mathematical / mech	anical analysis and model formation, and an	nly it to the context of	their own problems:
	 apply basic methods to engineering problems; 	aman analysis and model formation, and ap	pry it to the demant of	uion ouri probiomo,
	 estimate the reach and boundaries of the methods and 	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 over	ercome difficulties		
coolai compotento	The clade the can work in groupe and capper, cash calls to co			
Autonomy	Students are capable of determining their own strengths and	veaknesses and to organize their time and le	arning based on thos	se.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
		Machaniael Fanisaeriae Commulaeri		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisat			
Curricula	General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester)		nnuleony	
	General Engineering Science (German program, 7 semester)			
	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			
	General Engineering Science (English program, 7 semester):		npulsory	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	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 Complementa	ury Course Core Studies: Elective Compulsor	v	

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	- Simple impact problems - Principles of analytical mechanics - Elements of vibration theory - Vibration of Multi-degree of freedom systems - Multibody Systems	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).	



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

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



Module M1277: MED I: Intro	roduction to Anatomy		
Courses			
Title	Typ Hrs/w	wk	СР
Introduction to Anatomy (L0384)	Lecture 2		3
Module Responsible	Prof. Udo Schumacher		
Admission Requirements	s None		
Recommended Previous	s None		
Knowledge	е		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	е		
Knowledge	e 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	s The students can recognize the relationship between given anatomical facts and the development of some common	n diseases: th	nev can explain the
Okins	relevance of structures and their functions in the context of widespread diseases.	i discusco, ti	icy can explain the
Personal Competence	е		
Social Competence	e The students can participate in current discussions in biomedical research and medicine on a professional level.		
Autonomy	y The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and	d acquire the	relevant knowledge
,	themselves.		3.
Workload in Hours			
Credit points			
Examination			
Examination duration and scale	e 90 minutes		
Assignment for the Following		ulsory	
Curricula			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan	ınıcs: Compul	Isory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory	Leave	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Comput	isory	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	-: O	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan	nics: Compuis	sory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory		
	Biomedical Engineering: Specialisation Biomedical 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	эту			
Тур	Lecture			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Tobias Lange			
Language	DE .			
Cycle	SoSe 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 th week: Nervous System 13 th week: Exam			
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012			



Module M1278: MED I: Intro	oduction to Radiology and Radiation Therapy				
Na					
ourses	Tura Harrier CD				
itle troduction to Radiology and Radiation TI	Typ Hrs/wk CP herapy (L0383) Lecture 2 3				
Module Responsible					
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 distinguish different types of currently used equipment with respect to its use in radiation therapy.				
	The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e.g. surgery, internal medicine).				
	The students can describe the patients' passage from their initial admittance through to follow-up care.				
	Diagnostics				
	The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as 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 depending on the patient's clinical history and needs.				
	The student can explain the influence of technical errors on the imaging techniques.				
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.				
Skills	Therapy The students can distinguish curative and palliative situations and motivate why they came to that conclusion.				
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.				
	The students can use the therapeutic principle (effects vs adverse effects)				
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose tenergy needed in that situation (irradiation planning).				
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help group social services, psycho-oncology).				
	Diagnostics				
	The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.				
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology a pathophysiology.				
Personal Competence					
Social Competence	The students can assess the special social situation of tumor patients and interact with them in a professional way. The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet the				
	appropriately.				
Autonomy	The students can apply their new knowledge and skills to a concrete therapy case. The students can introduce younger students to the clinical daily routine.				
	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire t				
	relevant knowledge themselves.				
Workload in Hours					
Credit points					
Examination Examination duration and scale					
Assignment for the Following					
Curricula					
	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 Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	Mechanical Engineering: Specialisation Biomechanics: Compulsory				
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory				
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory				
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory				
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory				
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				



Course L0383: Introduction to Radio	ology and Radiation Therapy
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring DE
Language	SoSe SoSe
	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: Mechanical	Engineering: Design					
Courses						
		Tun	Urohuk	CD		
Title		Typ Lecture	Hrs/wk	CP		
Embodiment Design and 3D-CAD (L0268) Mechanical Design Project I (L0695)		Practical Course	2	2		
Mechanical Design Project II (L0592)		Practical Course	3	2		
Team Project Design Methodology (L0267	7)	Problem-based Learning	2	1		
Module Responsible	Prof. Dieter Krause	. Toblem babba Esaming				
Admission Requirements	None					
Recommended Previous						
Knowledge	 Fundamentals of Mechanical Engineering Design 					
Kilowicuge	Mechanics					
	 Fundamentals of Materials Science 					
	Production Engineering					
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results				
Professional Competence		· ·				
Knowledge	After passing the module, students are able to:					
G						
	 explain design guidelines for machinery parts e.g. cons 	dering load situation, materials and manufa	acturing requirements	,		
	 describe basics of 3D CAD, 					
	 explain basics methods of engineering designing. 					
Skills	After passing the module, students are able to:					
	independently create sketches technical drawings and	documentations e.g. using 3D CAD				
	 independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, 					
	dimension (calculate) used components,	modely,				
		ske systemtically and solution oriented				
	 use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. 					
	apply cleativity techniques in teams.					
Personal Competence						
Social Competence	After passing the module, students are able to:					
	develop and evaluate solutions in groups including making and documenting decisions,					
	moderate the use of scientific methods,					
	 present and discuss solutions and technical drawings w 	ithin groups				
	 reflect the own results in the work groups of the course. 	illiii groups,				
	ionoc, and countries and many groupe of the countries.					
Autonomy	Students are able					
	to estimate their level of knowledge using activating means.	ethods 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 Examination	6 Written exam					
Examination duration and scale	180					
Assignment for the Following	General Engineering Science (German program): Specialisation	n Energy and Environmental Engineering: C	Compulsory			
Curricula	General Engineering Science (German program): Specialisation	**	ompaisory			
Carriodia	General Engineering Science (German program): Specialisation					
		0 0 1 ,	mnulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory					
	General Engineering Science (English program): Specialisation		omnulsory			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	**	ompulsory			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation					
			moulcon			
	General Engineering Science (English program, 7 semester): S					
	General Engineering Science (English program, 7 semester): S			,		
	General Engineering Science (English program, 7 semester): S	peciansation Energy and Enviromental En	gineering: Compulsor	y		
	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					
CP	1				
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28				
Lecturer	Prof. Dieter Krause				
Language	DE				
Cycle	WiSe				
Content	Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings				
Literature	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-Ill; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff:/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. 				

Course L0695: Mechanical Design F	Project I		
Тур	Practical Course		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42		
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	WiSe		
Content	Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet		
Literature	 Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. 		



Course L0592: Mechanical Design F	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	roblem-based Learning			
Hrs/wk				
CP	1			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
Lecturer	Prof. Dieter Krause			
Language	DE			
Cycle	SoSe			
Content	Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides			
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen 			



Courses					
Γitle		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 of the students) 	r english) or Analysis & Linear Algebra I + II for	Technomathematicia	ans	
	 basic MATLAB 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				
, and modge					
	 name numerical methods for interpolation, integrati 	on, least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and	
	explain their core ideas,				
	 repeat convergence statements for the numerical me 	thods,			
	 explain aspects for the practical execution of numeric 	al methods with respect to computational and	storage complexitx.		
Skills	Students are able to				
	implement, apply and compare numerical methods u	sing MATLAR			
	justify the convergence behaviour of numerical meth		gorithm		
	select and execute a suitable solution approach for a		gonum,		
		g			
Personal Competence					
Social Competence	Students are able to				
	work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoreti-				
	 work together in neterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theorem foundations and support each other with practical aspects regarding the implementation of algorithms. 				
	loundations and support each other with practical as	sects regarding the implementation of algorith	110.		
Autonomy	Students are capable				
	• to access whether the augmenting theoretical and pro	otical everyings are better solved individually	or in a toom		
	 to assess whether the supporting theoretical and pra to assess their individual progess and, if necessary, 		or iii a teaiii,		
	to assess their individual progess and, innecessary,	o 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): 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		0 0	, ,	
	General Engineering Science (German program, 7 semeste		ory		
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engineering	, Focus Materials ir	Engineering Science	
	Compulsory				
	General Engineering Science (German program, 7 semeste): Specialisation Biomedical Engineering: Con	npulsory		
	General Engineering Science (German program, 7 semeste): Specialisation Mechanical Engineering, Foo	us Biomechanics: Co	mpulsory	
	Bioprocess Engineering: Specialisation A - General Bioproc	ess Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory				
	Electrical Engineering: Core qualification: Elective Compulsory				
	General Engineering Science (English program): Specialisation Computer Science: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory				
	General Engineering Science (English program): Specialisa	tion Mechanical Engineering, Focus Materials	in Engineering Scien	ces: Compulsory	
	General Engineering Science (English program, 7 semester	: Specialisation Computer Science: Compulso	ry		
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engineering	, Focus Materials in	Engineering Science	
	Compulsory				
	General Engineering Science (English program, 7 semester	: Specialisation Biomedical Engineering: Com	pulsory		
	General Engineering Science (English program, 7 semester	: Specialisation Mechanical Engineering, Foci	us Biomechanics: Coi	mpulsory	
	Computational Science and Engineering: Core qualification	0			
	Computational Science and Engineering. Core qualification	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, Dr. Patricio Farrell
Language	DE/EN
Cycle	WiSe
Content	 Error analysis: Number representation, error types, conditioning and stability Interpolation: polynomial and spline interpolation Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas Linear systems: LU and Cholesky factorization, matrix norms, conditioning Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization Eigenvalue problems: power iteration, inverse iteration, QR algorithm Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems
Literature	Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik 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, Dr. Patricio Farrell		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



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

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z. Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



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



	Laboratory Course
	Laboratory Course
	2
	2
+	Independent Study Time 32, Study Time in Lecture 28
+	Dr. Wolfgang Schröder
. 33.	DE
Cycle	WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftlich Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Münche 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
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Patrichenschalten und Kreinnungen gegrindt Kongligien, Äbelichkeitengesten
	Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3:
	 Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989
	Versuch 4:
	 Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen



Hrsiwit 2 Ob 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lacture 0. D. Swin Krause Language 05 Content 1 Fundamentals 1.1 Quantities and Units 1.2 Uncertainty 1.3 Calibration 1.4 Static and Dynamic Properties of Sensors and Systems 2.4 Measurement of Electrical Quantities 2.1 Quantities 2.2 Unpertainty 1.3 Calibration 2.4 Measurement of Electrical Quantities 2.2 Impediance 2.3 Amplification 2.4 Decilioscope 2.5 Analog-to-Ugital Conversion 2.4 Decilioscope 2.5 Analog-to-Ugital Conversion 2.8 Data Transmission 3. Measurement of Nonelectric Quantities 3.1 Temperature 3.2 Longht, Displacement, Angle 3.3 Striin, Force, Pressure 3.4 Flow 3.5 Time, Frequency 4. Chemical Analysis 4.1 Gas Sensors 4.2 Spectroscopy 4.5 Gas Chromatography All he end of each lecture students present single measuring techniques and results orally in front of the class. Literature 4. Literature 4. Protos, P. Pfeiter, T., Handbuch der industrietien Messeschnik; Cidenbourg, 2002; 183N: 978-3-486217940.	Course L1116: Measurement Techn	nology for Mechanical and Process Engineers
Workload in Naus Lecturer Dr. Sven Krause Language Cycle Cycle Content 1: Guardisles and Units 1: Quantities and Units 1: Quantities and Units 1: A Calibration 1: A Static and Dynamic Properties of Sensors and Systems 2: Measurement of Electrical Quantities 2: Current and Voltage 2: Impedance 2: A regulacion 2: A Oscilloscope 2: S Analog-to-Digital Conversion 2: A Data Transmission 3: Measurement of Nonelectric Quantities 3: Temperature 3: 2: Length, Displacement, Angle 3: Strain, Force, Pressure 3: A Fibre 3: Sime, Frequency 4: Chemical Analysis 4: Gas Sensors 4: 2 Spectroscopy 4: 3 Gas Chromatography At the end of each lecture students present single measuring techniques and results or all yin front of the class.	Тур	Lecture
Lecture Lect	Hrs/wk	2
Lacturer Dr. Sven Krisuse Cycle WiSo Content I Fundamenials 1.1 Outantiles 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 Anatog-to-Oligital 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, Fraquency 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		
Use Content Findamentals 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 Impediance 2.3 Amplification 2.4 Cacilloscope 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 Literature Lorch, R.: ≟liektrische Messtechnik; Analoge, digitale und computergestützte Verfarhern*, Springer, 2006, ISBN: 978-3-540-34055-3.		
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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.		2.2 Impedance
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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.		2.5 Analog-to-Digital Conversion
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.		2.6 Data Transmission
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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.		3.3 Strain, Force, Pressure
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.		3.4 Flow
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.		3.5 Time, Frequency
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.		4 Chemical Analysis
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.		4.1 Gas Sensors
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.		4.2 Spectroscopy
Literature Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.		4.3 Gas Chromatography
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Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.	Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.
		Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

Course L1118: Measurement Techn	Course L1118: Measurement Technology for Mechanical and Process Engineers	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1279: MED II: Intro	oduction to Biochemistry and Molec	cular Biology		
Courses				
Title		Тур	Hrs/wk	CP
ntroduction to Biochemistry and Molecular	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	The students can			
	describe basic biomolecules;			
	explain how genetic information is coded			
	explain the connection between DNA and	d proteins;		
Skills	The students can			
	recognize the importance of molecular pa			
	describe selected molecular-diagnostic p			
	explain the relevance of these procedure	s for some diseases		
Personal Competence				
Social Competence	The students can participate in discussions in re-	search and medicine on a technical level.		
, , , , , , , , , , , , , , , , , , , ,				
Autonomy	The students can develop understanding of topic	es from the course, using technical literature, by themse	lves.	
Workload in Hours	Independent Study Time 62, Study Time in Lectu	ire 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following): Specialisation Mechanical Engineering, Focus Biome	echanics: Compulsory	
Curricula): Specialisation Biomedical Engineering; Compulsory	scriamos. Compuisory	
Guiricula		, 7 semester): Specialisation Biomedical Engineering: (Compulsory	
		, 7 semester): Specialisation Biomedical Engineering, (mnulsony
	Electrical Engineering: Specialisation Medical Te		i oodo biomedianios. Oti	правоту
		: Specialisation Mechanical Engineering, Focus Biome	chanics: Compulsory	
		: Specialisation Biomedical Engineering: Compulsory	S. a. 1100. Compulsory	
		7 semester): Specialisation Mechanical Engineering, F	ocus Biomechanics: Con	nulsory
		7 semester): Specialisation Mechanical Engineering, 17		ipuisory
	Mechanical Engineering: Specialisation Biomecl	· ·	ompaisory	
	* * '	ment and Business Administration: Elective Compulsor	v	
		Organs and Regenerative Medicine: Elective Compuls	•	
		Technology and Control Theory: Elective Compulsory	or y	
	Biomedical Engineering: Specialisation Medical Biomedical Engineering: Specialisation Implants			
	Technomathematics: Core qualification: Elective	' ' '		
	Technomathematics: Specialisation III. Engineer	• •		
		g 33.3.00. Eloouvo compulatily		

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



Module M1333: BIO I: Impla	ints and Fracture Healing	
Courses		
Title	Typ Hrs/wk CP	
Implants and Fracture Healing (L0376)	Lecture 2 3	
Module Responsible	Prof. Michael Morlock	
Admission Requirements	None	
Recommended Previous	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence.	
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.	
Skille	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.	
OKIIIS	The students can determine the forces acting within the numan body under quasi-state situations under specific assumptions.	
Personal Competence		
Social Competence	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.	
Autonomy	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.	
Autonomy	The state his carr, in groups, solve basic numerical modelling tasks for the calculation of internal forces.	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Examination	Written exam	
Examination duration and scale	90 min	
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsory	
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory	
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	



Course L0376: Implants and Fractur	re Healing		
-	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Michael Morlock		
Language	E //Sa		
	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		
	9.5 Injuries and diseases		
	Pelvis (anatomy, biomechanics, fracture treatment)		
	5 Fracture Healing		
	5.1 Basics and biology of fracture repair		
	5.2 Clinical principals and terminology of fracture treatment		
	5.3 Biomechanics of fracture treatment		
	5.3.1 Screws		
	5.3.2 Plates		
	5.3.3 Nails		
	5.3.4 External fixation devices		
	5.3.5 Spine implants		
	6.0 New Implants		
Literature	Cochran V.B.: Orthopädische Biomechanik		
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics		
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine		
	Nigg, B.: Biomechanics of the musculo-skeletal system		
	Schiebler T.H., Schmidt W.: Anatomie		
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat		



Module 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	
Recommended Previous	
Knowledge	Busic Niewiedge of Matricinates 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
	explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the sub-disciplines in Management and to name important definitions from the sub-disciplines in Management and to name important definitions from the sub-disciplines in Management and to name important definitions.
	field of Management
	 explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and humanical contents.
	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
	apply methods for decision making under multiple objectives, under uncertainty and under risk analyses production and programment systems and Rusiness information systems.
	 analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	
Coolai Competendo	
	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
	A work in a team and to expanize the team the mackupa
	 work in a team and to organize the team themselves to write a report on their project.
	a to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following	
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 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 Mechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering



Compulsory

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

impulsory

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

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

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

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



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

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



Courses				
Title		Тур	Hrs/wk	CP
Experimental Methods in Biomechanics (L	0377)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate un	nd Frakturheilung" before attending "Experimentelle	e Methoden".	
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	The students can describe the different ways hov	v bones heal, and the requirements for their exister	nce.	
	The students can name different treatments for th	e spine and hollow bones under given fracture mo	rphologies.	
	The students can describe different measuremen	nt techniques for forces and movements, and choos	se the adequate technique for	r a given task.
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.			
Personal Competence				
Social Competence	The students can, in groups, solve basic experim	nental tasks.		
Autonomy	The students can, in groups, solve basic experim	ental tasks.		
Workload in Hours	Independent Study Time 62, Study Time in Lectu	re 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program)): Specialisation Mechanical Engineering, Focus Bi	iomechanics: Compulsory	
Curricula	General Engineering Science (German program)): Specialisation Biomedical Engineering: Compuls	sory	
	General Engineering Science (German program	, 7 semester): Specialisation Mechanical Engineeri	ng, Focus Biomechanics: Co	mpulsory
	General Engineering Science (German program	, 7 semester): Specialisation Biomedical Engineeri	ng: Compulsory	
	General Engineering Science (English program)	: Specialisation Biomedical Engineering: Compulso	ory	
	General Engineering Science (English program)	: Specialisation Mechanical Engineering, Focus Bio	omechanics: Compulsory	
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Engineering	ng, Focus Biomechanics: Cor	mpulsory
	General Engineering Science (English program,	7 semester): Specialisation Biomedical Engineerin	ng: Compulsory	
	Mechanical Engineering: Specialisation Biomech	nanics: Compulsory		
	Biomedical Engineering: Specialisation Artificial	Organs and Regenerative Medicine: Elective Com	pulsory	
	Biomedical Engineering: Specialisation Implants	and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical	Technology and Control Theory: Elective Compuls	ory	
	Biomedical Engineering: Specialisation Manage	ment and Business Administration: Elective Compu	ulsory	
	Technomathematics: Specialisation III. Engineeri	ing Science: Flective Compulsory		

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



Specialization Naval Architecture

Module M0933: Fundamen	tals of Materials Science			
Courses				
Title		Tun	Hrs/wk	СР
	/28	Typ Lecture	nrs/wk 2	2
Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture	2	2
Physical and Chemical Basics of Materials		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge	3			
Ü				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence	51			
Knowledge	The students have acquired a fundamental knowledge on me	tals, ceramics and polymers an	nd can describe this knowl	edae comprehensively
	Fundamental knowledge here means specifically the issues of atc			
	mechanical properties. The students know about the key aspects			
	characterizing specific properties. They are able to trace materials	henomena back to the underlying	g physical and chemical law	s of nature.
Skills	·			
	mechanical properties such as strength, ductility, and stiffness, che		•	
	solidification, precipitation, or melting. The students can explain the can account for the impact of microstructure on the material's behavior.		onditions and the materials	microstructure, and they
	can account for the impact of microstructure on the material's behavior	nor.		
B and C and				
Personal Competence				
Social Competence	-			
Autonomy Workload in Hours	Independent Childy Time OC Childy Time in Leature 94			
Workload in Hours Credit points	Independent Study Time 96, Study Time in Lecture 84			
Examination	Written exam			
Examination duration and scale	180 min			
		orgy and Environmental Engineer	ing: Compulacry	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Er General Engineering Science (German program): Specialisation M			
Odriicala	General Engineering Science (German program): Specialisation Bi			
	General Engineering Science (German program): Specialisation No		• 9	
	General Engineering Science (German program, 7 semester): Spec		g: Compulsory	
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviroment	tal Engineering: Compulsory	/
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En	ergy and Enviromental Engineeri	ng: Compulsory	
	General Engineering Science (English program): Specialisation Me	chanical Engineering: Compulso	ry	
	General Engineering Science (English program): Specialisation Bio	omedical Engineering: Compulsor	y	
	General Engineering Science (English program): Specialisation Na	val Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec		al Engineering: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elective	Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory	vo Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Electi	ve Compuisory		



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

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

Course L1095: Physical and Chemi	ical Basics of Materials Science		
Тур	Lecture		
Hrs/wk			
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	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 le	arning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of mar Marketing and Innovation, and also to Investment and Controlling. In		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management	nt and the sub-disciplines in Managem	ent and to name impo	ortant definitions from t
	field of Management	and an elementary of the control of		
	 explain the most important aspects of and goals in Managem describe and explain basic business functions as production 			
	ressource management, information management, innovatio		chair management,	ngamzation and num
	explain the relevance of planning and decision making in		Itiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected control	lling 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, objec	ctives, strategies etc) and to carry out
	• analyse Management goals and structure them appropriately			
	 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			
	 analyse and apply basic methods of marketing 			
	select and apply basic methods from mathematical finance to	predefined problems		
	 apply basic methods from accounting, costing and controlling 	to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	work successfully in a team of students			
	to apply their knowledge from the lecture to an entrepreneurs	hip project and write a coherent repor	t on the project	
	to communicate appropriately and			
	 to cooperate respectfully with their fellow students. 			
Autonomy	Students are able to			
	 work in a team and to organize the team themselves 			
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Ele	ctrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Co			
	General Engineering Science (German program): Specialisation Pro			
	General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation En		ompulsory	
	General Engineering Science (German program): Specialisation Civ			
	General Engineering Science (German program): Specialisation Me		, ,	
	General Engineering Science (German program): Specialisation Bio	medical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Na	val Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci		•	
	General Engineering Science (German program, 7 semester): Speci General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester). Speci	·	-	
	General Engineering Science (German program, 7 semester): Speci	·	•	
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci	alisation Energy and Enviromental En	gineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Speci	alisation Mechanical Engineering, Foo	us Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci		-	
	General Engineering Science (German program, 7 semester): S Compulsory	pecialisation Mechanical Engineering	J, ⊢ocus Materials ir	Engineering Scienc
	General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineering	Focus Theoretical M	Aechanical Engineering



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:

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



Tun	Lacture			
Typ				
Hrs/wk	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wo			
Lammana	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona			
Language	DE WiSe/SoSe			
Cycle	WI26/2026			
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 			
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008			
	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003			
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.			
Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.				
	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.			
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.			
	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.			

Course L0882: Project Entrepreneurship				
Тур	Problem-based Learning			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Christoph Ihl, Ann-Isabell Hnida, Hamed Farhadian, Katharina Roedelius, Oliver Welling, Maximilian Muelke			
Language	DE			
Cycle	WiSe/SoSe			
Content	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	СР	
Differential Equations 2 (Partial Differentia	Equations) (L1043)	Lecture	2	1	
Differential Equations 2 (Partial Differentia	Equations) (L1044)	Recitation Section (small)	1	1	
Differential Equations 2 (Partial Differentia	Equations) (L1045)	Recitation Section (large)	1	1	
Complex Functions (L1038)		Lecture	2	1	
Complex Functions (L1041)		Recitation Section (small)	1	1	
Complex Functions (L1042)		Recitation Section (large)	1	1	
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	none				
Recommended Previous	Mathematics 1 - III				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the	following learning results			
•	Alter taking part successionly, students have reached the	lollowing learning results			
Professional Competence					
Knowledge	Students can name the basic concepts in Mathen	natics IV. They are able to explain them using appro	onriate examples		
	Students can discuss logical connections between			ith the help of example	
			uiese coillections w	itir trie rieip or example:	
	They know proof strategies and can reproduce them.				
Skills					
	 Students can model problems in Mathematics IV 	with the help of the concepts studied in this course	e. Moreover, they are	capable of solving the	
	by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course.				
	For a given problem, the students can develop ar	nd execute a suitable approach, and are able to crit	ically 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				
	check and deepen the understanding of their pee	ers.			
Autonomy	Students are capable of checking their understa	nding of complex concepts on their own. They can	n specify open ques	tions precisely and kno	
	where to get help in solving them.	name of complex concepts on their own. They ca	ir speeily open ques	none productly and kind	
	 Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented 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 Equat	ions 2)			
Assignment for the Following	General Engineering Science (German program): Specia	·			
•		0 0 1 ,			
Curricula	General Engineering Science (German program): Specia	• •			
	General Engineering Science (German program): Specia		al Mechanical Engin	eering: Compulsory	
	General Engineering Science (German program): Specia	alisation Naval Architecture: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical Engineering, Foci	us Mechatronics: Co	mpulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering				
	Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory				
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory				
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (English program): Specialisation Nechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering				
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory				
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory				
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory				
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory				
	Mechanical Engineering: Specialisation Mechatronics: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory				
		mentary Course Coro Studios: Floativo Compulari	,		



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

Course L1044: Differential Equations 2 (Partial Differential Equations)		
Тур	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			
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	Main features of complex analysis		
	Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation		
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html		



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

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



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

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	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	SoSe	
Content	- Simple impact problems - Principles of analytical mechanics - Elements of vibration theory - Vibration of Multi-degree of freedom systems - 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). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).	



Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	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	chanics 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 th	e general principles of fluid engineering an	d physics of fluids.	Students can scientificall
	outline the rationale of flow physics using mathematical model	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	-physics models for the analysis of technics	al evetame. The lecti	ire anables the student to
OKIIIS	carry out all necessary theoretical calculations for the fluid dyna			ire enables the student to
	carry car an incooccary anonouscal canonication on the maid aying	a coolgii or originoomig actioco on a colo		
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop s	olution strategies.		
Autonomy	The students are able to develop solution strategies for complex	problems self-consistent and crtically analy	se results.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	n Biomedical Engineering: Compulsory		
	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		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		у	
	Mechanical Engineering: Core qualification: Compulsory	Compulsory		
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		
	and the state of t			

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



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	Tasketal and backs			
Knowledge	Technical mechanics Linear alrahar analysis appraisurables			
	Linear algebra, analysis, complex numbers Fluid mechanics			
	• Fluid medianics			
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	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 determine	ne forces and motions in waves.		
Skills	- The students can come up with the equations of motions which are used	to discribe manoeuvres. The can use	and linearise the	m.
	- The students are able to determine hydrodynamic coefficients and they c	an explain their physical meaning.		
	- The students can explain how a rudder works and they can explain the p	hysical 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): Specialisati	ion Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisation Naval Arc	chitecture: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation	on Naval Architecture: Compulsory		
	Naval Architecture: Core qualification: Compulsory			



Course L0352: Ship Dynamics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships
	 Equations of motion Hydrodynamic forces and moments Linear equations and their solutions Full-scale trials for evaluating the maneuvering performance Regulations for maneuverability Rudder Seakeeping Representation of harmonic processes Motions of a rigid ship in regular waves
	Flow forces on ship cross sections Strip method Consequences induced by ship motion in regular waves Behavior of ships in a stationary sea state Long-term distribution of seaway influences
Literature	 Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg 2014 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University of Technology, 2014 Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United Kingdom, 2000 Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada, 1978 Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993 Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I-II, Springer-Verlag. Berlin Heidelberg, Deutschland, 1992 Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, United Kingdom, 1990 Handbuch der Werften, Deutschland, 1986 Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001 Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability, Society of Naval Architects and Marine Engineers Jersey City, NJ, 1989 Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004 Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998

Course L1620: Ship Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0364: Statistics and Stoch	astic Processes in Naval Architecure and Ocean Engineering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, John Wiley & Sons, Inc., New York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaā, 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



Modulo M0655: Computation	anal Eluid 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	Moth continued Mathematical Francisco			
Knowledge	 Mathematical Methods for Engineers Fundamentals of Differential/integral calculus and so 	arios expansions		
	Fundamentals of Differential/Integral calculus and Se	mes expansions		
Educational Objectives	After taking part successfully, students have reached the fol	owing learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial dif	erential equations.		
Skills	The students are able develop appropriate numerical inte	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	r): Specialisation Naval Architecture: Compulso	ry	
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engineering, Foci	us Energy Systems: I	Elective Compulsory
	General Engineering Science (English program): Specialisa	ation Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisa	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		
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	
	3. Computation of potential flows 4. Introduction of finite-differences 5. According to a factor of the state of the st	
	Approximation of convective, diffusive and transient transport processes Formulation of boundary conditions and initial conditions 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			
	146			
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 calculation of linear deformations and stresses in the above mentioned structures; they			
	can choose calculation models of typical ship structures.			
	Furthermore, they are capable to apply the methods of drawing a	and sizing the ship structure; they can se	elect suitable material	s, semi-finished product
	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
	9. Determining the scantlings of longitudinal structural members
	10. Determining the scantlings of bottom and side structures
	11. Decks and Hatch Openings
	12. Effective breadth
	13. Iterative determination of scantlings (POSEIDON)
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

Course L0413: Fundamentals of Ship Structural Design		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Chapters:	
	1. Introduction	
	3. Class societies and their tasks	
	4. Materials for steel shipbuilding	
	5. Welding and Cutting	
	6. Semi-finished products in steel shipbuilding	
	7. Determining the scantlings for local loads	
	8. Longitudinal strength of the hull girder	
	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	ecitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Contents:	
	1. Introduction	
	2. Finite element method (f.e. method) by the example of trussworks	
	3. Force methods for frameworks	
	4. F.e. method for frameworks	
	5. Shear and torsion in thin-walled beams	
	6. Beams subjected to longitudinal forces	
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente	



Module M0664: Structural 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 telling and the control of the	ha fallaccia a la craina na culta		
Educational Objectives	After taking part successfully, students have reached t	ne lollowing learning results		
Professional Competence				
Knowledge	Students can reproduce design and sizing as well as		and of different ship t	ypes (incl. detail design);
	they can describe calculation models for complex stru	ctures.		
Skills	Students are capable to specify the requirements for		e design criteria for th	ne 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 discuss their decisions constructively in a grou	p.	
Autonomy	Students are capable to design independently differ	ant structural areas of the ship hull and different sh	ain types and to defin	a appropriate fabrication
Autonomy		ent structural areas of the ship fruit and different si	iip types and to deliii	е арргорпате тарпсатоп
	methods.			
Workload in Hours	Independent Study Time 172, Study Time in Lecture 9	8		
Credit points	9			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Naval Architecture: Compulsorv		
Curricula	General Engineering Science (German program, 7 se		orv	
32.710010	General Engineering Science (English program): Spe		- /	
	General Engineering Science (English program, 7 ser	· · ·	one	
	Naval Architecture: Core qualification: Compulsory	nostor). Oposiansation wavai Alemtestale. Compuisi	O. y	
	144441 / World Goldre. Oore 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:	
	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	
Literature	9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	
	3.4.3.4.4.	



Course L0415: Ship Structural Design	
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Chapters:
Liberatura	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	es and Body Plan			
Courses				
Title		Тур	Hrs/wk	СР
Hydrostatics (L1260)		Lecture	2	3
Hydrostatics (L1261)		Recitation Section (large)	2	1
Body Plan (L1452)		Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Good knowledge in Mathemathics I-III and Mechanics I-	III.		
Knowledge	It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan, GA- Plan, Tank Plan etc.			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
	all following lectures in the subjects shipo design and si	afety of ships.		
Skills	The student is able to carry out hydrostatic calculations to ensure that the ship has sufficient stability. He is able to design hull forms that are safe again			
	capsizing or sinking.			
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): Spec	ialisation Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architecture: Compuls	sory	
	General Engineering Science (English program): Speci	alisation Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Naval Architecture: Compulse	ory	
	Naval Architecture: Core qualification: Compulsory			

Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	1. Numerical Integration, Diffrentation, Interpolation
Content	- 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



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

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



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

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

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

Course L1452: Body Plan	
Тур	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of: - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	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	СР
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Manharita			
Knowledge	Mechanics Third Provides for Neverlands that the state of the st			
	Fluid Dynamics for Naval Architects			
	Hydrostratics			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for resistance and pro	pulsion of ships are discussed. The diffe	erent resistance pheno	omena and their practical
	applications to hullform design as well as numerical and empirical	al prediction methods are subject of the	course. Furthermore,	environmental additional
	resistances are dealt with. The course includes model test tecl	hniques and their application to full se	cale ships. This hold	also for propulsion and
	hullefficiency elements, mainly thrust deduction and wake. Ma	ain Focus is how hull forms can be	optimized for minimu	ım and sustainable fue
	consumption. The following topics are dealt with:			
	- Stillwater/added resistance Wave resistance Minimization of	wave resistance numerical prediction	methods friction law	rs laminar/turbulent flow
	- 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 sta			
Skills	s The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls			
	by several progosis methods. Furtermore, the course will en	nable the student to clearl determine	and minimize the re	equired power including
	environmental influences.			
Personal Competence				
Social Competence	The student learns to prepare technical matters in such a way that	he can compte with his building suvervi	sion team.	
Autonomy	The student learns to prepare technical matters in such a way that	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 N	Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spe	ecialisation Naval Architecture: Compuls	ory	
	General Engineering Science (English program): Specialisation N	aval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Spe	cialisation Naval Architecture: Compulso	ory	
	Naval Architecture: Core qualification: Compulsory			

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

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



Module M1110: Ship Desig	n			
Courses				
Title		Тур	Hrs/wk	СР
Ship Design (L1262)		Lecture	2	3
Ship Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Fl. M.D. and M. C. Marcel Andrian In Proceedings of Procedenge of Proceedings of Proceedings of Proceedings of Proceedings of Proceedings of Proceedings of Procedenge of Proced	late a		
Knowledge	Fluid Dynamics for Naval Architects, Resistance and Propulation, Hydrostatics	ision		
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the importance and r	equirements of the aerly design pha	ase. Competitive Eleme	nts of Ship Designs ar
	thoroughly discussed. Typical bulding contracts and the related	technical risk are introduced. The	most important main pa	arameters of a ship ar
	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 elem-	ents. In this lecture, the design chang	es are dealt with by sim	nple models or formulae
	The student shall further learn to model complex systems properly	so that the relavent technical conclusi	ons can be drawn.	
	The lecture continues with an introduction into the different phases	of design project, from the initial design	gn phase to a building c	ontract. Further, method
	are introduced to generate bulding specification relevant informa			
	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			
	- Helevant fules and regulations			
Skills	The student is made familiar with the basic design principles of s	seagoing mearchant ships. The goal	of the lecture is that the	student shall be able t
	carry out a concept design based on a vessel of comparison fulfilli	ng typical contract requirements withir	n the Marine Environme	nt. The lecture deals wit
	the basic design methods to determine the fundamantal technical			
	values. Based on the lecture "Principles of Ship Design" the releva	ant methods to determine and judge ud	opn the performance of a	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	ner against his competito	ors.
	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	laval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spe		lsory	
	General Engineering Science (English program): Specialisation N	·	•	
	General Engineering Science (English program, 7 semester): Spe		Isory	
	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				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After passing this module the students have the ability to):		
	give an overview of the most important fields on p overlain same working methods for different fields.			
	 explain some working methods for different fields 	s in process engineering.		
Skills	After passing this module the students should have the a	ability to:		
	 list and outline the most important fields of proces 	ss engineering		
	name the most important working approaches or		eering	
	read and prepare an engineering drawing,		oog,	
	explain the most important technologies for waster	ewater and exhaust air treatment		
	scheme typical chemical and biotechnological pri			
	,,	. ,		
Personal Competence				
Social Competence	The students are able to			
	 work out results in groups and document them, 			
	 provide appropriate feedback and handle feedback 	ack on their own performance constructively.		
		•		
	The short on the second state of the second st	and a bottle section of the section	teste effect to the first	
Autonomy	The students are able to estimate their progress of le	earning by themselves and to deliberate their	rack of knowledge in P	rocess Engineering and
	Bioprocess Engineering.			
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Speci	alisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speci	alisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 seme	ester): Specialisation Process Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 seme	ester): Specialisation Bioprocess Engineering:	Compulsory	
	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: Com	npulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Engineering: C	Compulsory	
	Process Engineering: Core qualification: Compulsory			



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

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



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

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



Course L0835: Physical Chemistry	
Тур	Laboratory Course
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
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 eq 	uations		
	Integration			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	3,			
Knowledge	Students are able to:			
	a cyclain the difference between different types of fl	011		
	 explain the difference between different types of fl give an overview for different applications of the F 		rina	
	explain simplifications of the Continuity- and Navi		-	
Skills	The students are able to			
	describe and model incompressible flows mathematically			
	 reduce the governing equations of fluid mechanic 	s by simplifications to archive quantitative solution	ons e.g. by integration	
	notice the dependency between theory and techn			
	 use the learned basics for fluid dynamical applica 	tions in fields of process engineering		
Personal Competence				
Social Competence	The students			
	are capable to gather information from subject relationships.	ated, professional publications and relate that inf	ormation to the contex	t of the lecture and
	able to work together on subject related tasks in s			
	exercises)			
	are able to work out solutions for exercises by the	mselves, 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 expa			
	work on their exercises by their own and to evaluate	tte their actual knowledge with the leedback.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specia			
Curricula	General Engineering Science (German program): Special General Engineering Science (German program): Special		Compulsor.	
	General Engineering Science (German program, 7 seme	0,	, ,	
	General Engineering Science (German program, 7 seme	, ,	•	
	General Engineering Science (German program, 7 seme			ry
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification			
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special		ompulsory	
	General Engineering Science (English program): Special General Engineering Science (English program, 7 semes	0 0 1 ,	ilsory	
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes			у
	Technomathematics: Specialisation III. Engineering Scien	* *		
	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	 fluid properties hydrostatic overall balances - theory of streamline overall balances - conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course L0092: Fluid Mechanics for Pr	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
1	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.



Module M0544: Phase Equ	ilibria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	CP
Phase Equilibria Thermodynamics (L0114		Lecture	2	2
Phase Equilibria Thermodynamics (L0140		Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (L0142		Recitation Section (Image)	1	2
Module Responsible	Prof. Irina Smirnova	rissitation ession (large)	· · · · · · · · · · · · · · · · · · ·	
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 basics of thermodynamics, the st 	tudents learn the mathematical tools to descri	ribe thermodynamic ed	quilibria.
	 They learn how state variables are influenced by the m 	nixing of compounds and learn concepts to q	uantitatively describe	these properties.
	 Moreover, the students learn how phase equilibria car 	n be described mathematically and which ph	enomena may occur i	f different phases (vapor
	liquid, solid) coexist in equilibrium. Furthermore the fur	ndamentals of reaction equilibria are taught.		
	 For different phase equilibria, several examples relevant 	ant for different kinds of processes are shown	and the necessary ki	nowledge for plotting and
	interpreting the equilibria are taught.			
Skills	 Applying their knowledge, the students are able to id 	entify the correct equation for the determina	ation of the equilibriur	n state and know how to
	simplify these equations meaningfully.	,		
	The students know models which can be used to determine the students know models which can be used to determine the students which can be used to det	armine the properties of the system in the e	auilibrium etata and t	hey are able to solve the
	resulting mathematical relations.	cinino die properties of the system in the e	quiibiidiii olale and l	ncy are able to solve an
	For specific applications, they are able to self-reliantly	find noncestry physics chemical proportion	of compounds as wol	Lac model parameters is
		illu necessary physico-chemical properties	or compounds as wer	i as model parameters ii
	literature sources.		_	
	Beside pure compound properties the students are cap			
	The students know how to visualize phase equilibria g			
	Based on their knowledge, the students are able to	understand fundamental concepts that are	e 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 cor	responding problems and to present them o	raly to the tutors and o	ther students
Autonomy	g. 12pc, 10 10.13 (110 00.1	. 0,	,	
Autonomy	 The students are able to find necessary information se 	If-reliantly in literature sources and to judge	their quality.	
	During the semester the students are able to check the	eir learning progress continuously in exercis	ses. Based on this kno	wledge the students car
	adept their learning process.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisati	ion Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisati	ion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester):		•	
	Bioprocess Engineering: Core qualification: Compulsory	. ,	. ,	
	General Engineering Science (English program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation		loon	
	General Engineering Science (English program, 7 semester):		•	
	General Engineering Science (English program, 7 semester):	opecialisation Bioprocess Engineering: Cor	npulsory	
	Process Engineering: Core qualification: Compulsory			



Course L0114: Phase Equilibria The	rmodynamics
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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course L0140: Phase Equilibria The	rmodynamics
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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Course L0142: Phase Equilibria The	rmodynamics
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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Module M0757: Biochemist	ry 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 learning	ng results		
Professional Competence				
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical research to determin	e 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 discussions	in teams		
	- to divide a complex task into subtasks, solve these and to present the co			
	- to divide a complex task into subtasks, solve these and to present the co	חווטווופט ופטעונט		
Autonomy	The students are able to present the results of their subtasks in a written r	eport		
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 Bioproce			
Curricula	General Engineering Science (German program, 7 semester): Specialisa	tion Bioprocess Engineering: Comp	oulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bioproce			
	General Engineering Science (English program, 7 semester): Specialisat		ulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Co	mpulsory		



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
	3. Lipids
	3. Protein functions, Enzymes:
	Michaelis-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

Course L0728: Biochemistry	
Тур	Problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	1. The molecular logic of Life 2. Biomolecules: 1. Amino acids, peptides, proteins 2. Carbohydrates 3. Lipids 3. Protein functions, Enzymes: 1. Michaelis-Menten kinetics 2. Enzyme regulation 3. Enzyme nomenclature 4. Cofactors and cosubstrates, vitamines 5. Metabolism: 1. Basic principles
	2. Photosynthesis 3. Glycolysis 4. Citric acid cycle 5. Respiration 6. Anaerobic respirations 7. Fatty acid metabolism 8. Amino acid metabolism
Literature	Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn, Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin



Course L0881: Microbiology	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. 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
	O Mataballan
	2. Metabolism
	fermentation and anaerobic respiration
	methanogenesis and the anaerobic food chain
	degradation of polymers
	chemolithotrophy
	3. Microorganisms in relation to the environment
	chemotaxis and motility
	Elemental cycle of carbon, nitrogen and sulfur
	• biofilms
	symbiotic relationships
	• extremophiles
	biotechnology
Literature	
	• Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)
	• Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €)
	Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag
	• Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/



Course L0888: Microbiology	
Тур	Problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	1. The procaryotic cell
	evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth 2. Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy 3. Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles
	biotechnology
Literature	 Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €)
	Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag
	• Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/



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 None
Recommended Previous	Mathematics 1-3
Knowledge	manormanos i o
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathematik 1-3 is 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 which
	caused by the transition of a continuous-time signal to a discrete-time signal.
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory.
	can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can a
	the impact of LTI systems on the signal properties in time and frequency domain.
Personal Competence	
Social Competence	The students can jointly solve specific problems.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the le
·	period by solving tutorial problems, software tools, clicker system.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engine
	Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



ourses	ns of Management			
tle		Тур	Hrs/wk	CP
roduction to Management (L0880) oject Entrepreneurship (L0882)		Lecture Problem-based Learning	3	3
Module Responsible	Prof. Christoph Ihl	1 Tobiem-based Learning	2	3
Admission Requirements	·			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics o Marketing and Innovation, and also to Investment and Controllin		nagement, from Planr	ning and Organisation
	explain the differences between Economics and Manag	ement and the sub-disciplines in Manageme	ent and to name impo	ortant definitions from t
	field of Management	agement and name the most important cane	ata of antronracurial r	raiaata
	 explain the most important aspects of and goals in Mana describe and explain basic business functions as proc 			
	ressource management, information management, inno		onam management, c	organization and nam
	explain the relevance of planning and decision making		tiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected of	ontrolling 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
	 analyse Management goals and structure them appropr analyse organisational and staff structures of companies 	•		
	apply methods for decision making under multiple objections.			
	analyse production and procurement systems and Busin			
	analyse and apply basic methods of marketing	,		
	select and apply basic methods from mathematical finar	ce to predefined problems		
	apply basic methods from accounting, costing and contri	olling to predefined problems		
Personal Competence				
Social Competence				
	and an according to a top of at death			
	 work successfully in a team of students to apply their knowledge from the lecture to an entrepret 	acurchin project and write a coherent report	on the project	
	to apply their knowledge from the lecture to all entrepren to communicate appropriately and	redistrip project and write a correlent 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.			
	Independent Study Time 110, Study Time in Lecture 70			
Workload in Hours				
Workload in Hours Credit points	6			
Credit points	Written exam			
Credit points Examination	Written exam 90 minutes	n Electrical Engineering: Compulsory		
Credit points Examination Examination duration and scale	Written exam 90 minutes General Engineering Science (German program): Specialisatio			
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory		
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co	, ,	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Cor	, ,	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Con n Civil- and Enviromental Engeneering: Con n Mechanical Engineering: Compulsory	, ,	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Environmental Engineering: Con n Civil- and Environmental Engeneering: Con n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory	, ,	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Cor n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory	npulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Cor n Civil- and Enviromental Engeneering: Cor n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Comp	ulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program, 7 semester): Specialisatio General Engineering Science (German program): Specialisatio General Engineering Science	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compu	ulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program, 7 semester): Seneral Engineering Science (German program): Seneral Engineering Science (German program): Seneral Engineering Science (German program): Seneral	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compu specialisation Process Engineering: Compu specialisation Biomedical Engineering: Compu specialisation Biomedical Engineering: Compu	ulsory lsory npulsory ry	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program, 7 semester): Seciencal Engineering Science (German program): Seciencal Engineering Science (German program): Secien	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compu specialisation Process Engineering: Compu specialisation Biomedical Engineering: Compu specialisation Biomedical Engineering: Compu specialisation Naval Architecture: Compulsory	ulsory lsory npulsory rry	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program, 7 semester): Seciencal Engineering Science (German program, 7 semester): Secience (German program, 7 semester): Secience (German program, 7 semester): Secience (German program): Secience (German program): Secience (German program): Sec	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Con n Civil- and Enviromental Engeneering: Con n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compu specialisation Process Engineering: Compu specialisation Biomedical Engineering: Compu specialisation Naval Architecture: Compulsory specialisation Omputer Science: Compulsory specialisation Dioprocess Engineering: Compulsory	ulsory lsory npulsory rry ory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisatio General Engineering Science (German program, 7 semester): Seciencal Engineering Science (German prog	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Con n Civil- and Enviromental Engeneering: Con n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compu specialisation Process Engineering: Compu specialisation Biomedical Engineering: Compu specialisation Naval Architecture: Compulsor specialisation Computer Science: Compulsor specialisation Bioprocess Engineering: Com specialisation Bioprocess Engineering: Compulsor specialisation Bioprocess Engineering: Compulsor	ulsory lsory ipulsory iry ory ipulsory	·
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Cor n Civil- and Enviromental Engeneering: Cor n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compulsory specialisation Process Engineering: Compulsory specialisation Biomedical Engineering: Compulsory specialisation December Science: Compulsory specialisation Biomedical Engineering: Compulsory specialisation Computer Science: Compulsory specialisation Bioprocess Engineering: Compulsory specialisation Bioprocess Engineering: Compulsory specialisation Civil Engineering: Compulsory specialisation Civil Engineering: Compulsory	ulsory lsory pulsory pry pry pulsory y gineering: Compulsory	
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Com n Civil- and Enviromental Engeneering: Com n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compulsory specialisation Process Engineering: Compulsory specialisation Biomedical Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Computer Science: Compulsory specialisation Bioprocess Engineering: Compulsor specialisation Engineering: Compulsor specialisation Civil Engineering: Compulsor specialisation Energy and Enviromental Engipeering, Focialisation Mechanical Engineering, Foci	ulsory lsory pulsory pry pry pulsory y gineering: Compulsory us Mechatronics: Con	npulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Com n Civil- and Enviromental Engeneering: Com n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compulsory specialisation Process Engineering: Compulsory specialisation Biomedical Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Computer Science: Compulsor specialisation Engineering: Compulsor specialisation Bioprocess Engineering: Compulsor specialisation Energy and Enviromental Engineering, Fociopecialisation Mechanical Engineer	ulsory Isory Isory Ipulsory Inpulsory Inpulsor	npulsory mpulsory
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Compulsory n Energy and Enviromental Engineering: Compulsory n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compulsory specialisation Process Engineering: Compulsory specialisation Biomedical Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Computer Science: Compulsory specialisation Bioprocess Engineering: Compulsory specialisation Energy and Enviromental Engineering, Fociopecialisation Mechanical Engineering, Fociopecialisatio	ulsory Isory Isory Ipulsory Ip	npulsory mpulsory ngineering: Compulso
Credit points Examination Examination duration and scale Assignment for the Following	Written exam 90 minutes General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (German	n Computer Science: Compulsory n Process Engineering: Compulsory n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Compulsory n Energy and Enviromental Engineering: Compulsory n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory specialisation Electrical Engineering: Compulsory specialisation Process Engineering: Compulsory specialisation Biomedical Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Decense Engineering: Compulsory specialisation Computer Science: Compulsory specialisation Bioprocess Engineering: Compulsory specialisation Energy and Enviromental Engineering, Fociopecialisation Mechanical Engineering, Fociopecialisatio	ulsory Isory Isory Ipulsory Ip	npulsory mpulsory ngineering: Compulso



Compulsory

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

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Mana	gement
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	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

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



Module M0938: Bioprocess	Engineering - Fundamentals			
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 "fundamentals for pro	cess engineering"		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processes in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail.			
	After successful completion of this module, students should be able to describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem propose solutions to complicated biotechnological problems and to deduce the corresponding models to explore new knowledge resources and to apply the newly gained contents identify scientific problems with concrete industrial use and to formulate solutions. to document and discuss their procedures as well as results in a scientific manner			
Personal Competence Social Competence Autonomy	After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork in engineering and scientific environments.			
Workload in Hours	Independent Study Time OS Study Time in Lecture 94			
	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min	Process Facility of the Control		
Assignment for the Following				
Curricula	General Engineering Science (German program): Specialisation		loon	
	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S			
	Bioprocess Engineering: Core qualification: Compulsory	beclansation bioprocess Engineering. Con	ipuisory	
	General Engineering Science (English program): Specialisation	Rionrocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		sorv	
	General Engineering Science (English program, 7 semester): Sp.			
	Biomedical Engineering: Specialisation Artificial Organs and Re		r = . 30. j	
	Biomedical Engineering: Specialisation Implants and Endoprost			
	Biomedical Engineering: Specialisation Medical Technology and	• •		
	Biomedical Engineering: Specialisation Management and Busin			
	Technomathematics: Specialisation III. Engineering Science: Ele			
	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	 Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese) Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese) Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng) Kinetic of subtrate consumption and product formation (Prof. Zeng) Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese) Transport process in a bioreactor (Prof. Zeng) Technology of sterilization (Prof. Zeng) Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese) Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)
Literature	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Course L0842: Bioprocess Engineering- Fundamentals	
Тур	Recitation Section (large)
Hrs/wk	2
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 N	lass Transfer			
Courses				
Courses		Tun	Heaturk	CD
Title Heat and Mass Transfer (L0101)		Typ Lecture	Hrs/wk 2	CP 2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge	,			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge				
	The students are capable of explaining qualitative and det	ermining quantitative heat transfer in	procedural apparatu	s (e. g. heat exchanger
	chemical reactors).			
	 They are capable of distinguish and characterize different ki radiation. 	nds of neat transfer mechanisms name	ery neat conduction, r	ieat transier and therma
	The students have the ability to explain the physical basis for	mace transfer in detail and to describe	mace transfer qualit	tative and quantitative by
	using suitable mass transfer theories.	mass transfer in detail and to describe	s mass hansler quali	lative and quantitative by
	They are able to depict the analogy between heat- and mass	transfer and to describe complex linker	d processes in detail	
	,			
Skills	The students are able to set reasonable system boundaries	for a given transport problem by usin	ng the gained knowle	edge and to balance the
	corresponding energy and mass flow, respectively.	i lor a given transport problem by asir	ig the gamea known	sage and to balance and
	They are capable to solve specific heat transfer problems (in the solution of the solution).	e.g. heated chemical reactors, tempera	ature alteration in flu	ids) and to calculate the
	corresponding heat flows.	sig. Hould's chombal rousions, tempers	atoro attoration in ita	ido, and to carcarate are
	Using dimensionless quantities, the students can execute sca	aling up of technical processes or appa	ratus.	
	They are able to distinguish between diffusion, convective relationships to the convention of the			ledge for the description
	and design of apparatus (e.g. extraction column, rectification		•	
	In this context, the students are capable to choose and context.	lesign fundamental types of heat and	d mass exchanger fo	or a specific application
	considering their advantages and disadvantages, respective	y.		
	In addition, they can calculate both, steady-state and non-ste	ady-state processes in procedural appa	aratus.	
	The students are capable to connect their knowledge ob	ained in this course with knowlegde	e of other courses (I	n particular the courses
	thermodynamics, fluid mechanics and chemical process engi	neering) to solve concrete technical pro-	oblems.	
Personal Competence				
Social Competence	The students are capable to work on subject-specific challer	iges in teams and to present the result	s orally in a reasona	hle manner to tutors and
	other students.	iges in teams and to present the result	s orany iii a reasona	
	Salet stade her			
Autonomy				
Autonomy	The students are able to find and evaluate necessary information.	tion from suitable sources		
	They are able to prove their level of knowledge during to		dure continuously (c	licker-system, exam-like
	assignments) and on this basis they can control their learning	processes.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
	6		<u> </u>	
Credit points	0			
Credit points Examination	Written exam			
	Written exam			
Examination	Written exam 120 minutes; theoretical questions and calculations	cess Engineering: Compulsory		
Examination Examination duration and scale	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Pro			
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Pro	process Engineering: Compulsory	ompulsory	
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program Ingineering Science (German program): Specialisation Bio	process Engineering: Compulsory ergy and Enviromental Engineering: Co		
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program I Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engineering Science (German program): Spe	process Engineering: Compulsory ergy and Enviromental Engineering: Co alisation Process Engineering: Compul	lsory	
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program): Specialisation Engineering	process Engineering: Compulsory orgy and Enviromental Engineering: Co alisation Process Engineering: Compul alisation Bioprocess Engineering: Com	lsory	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program): Specialisation Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program): Specialisation Engin	process Engineering: Compulsory orgy and Enviromental Engineering: Co alisation Process Engineering: Compul alisation Bioprocess Engineering: Com	lsory	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special Engineering Science (German program, 7 semester): Specialisation Program (German program): Specialisation Engineering Science (German program): Specialisation Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program): Speciali	process Engineering: Compulsory ergy and Enviromental Engineering: Co- alisation Process Engineering: Compulalisation Bioprocess Engineering: Com- alisation Energy and Enviromental Eng	lsory	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special Engineering Science (German program, 7 semester): Special Engineering Science (German program, 7 semester): Special Engineering: Core qualification: Compulsory	process Engineering: Compulsory ergy and Enviromental Engineering: Co- alisation Process Engineering: Compulalisation Bioprocess Engineering: Com- alisation Energy and Enviromental Eng	lsory	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special Engineering Science (German program, 7 semester): Special Engineering Science (German program, 7 semester): Special Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory	process Engineering: Compulsory ergy and Enviromental Engineering: Co alisation Process Engineering: Compul alisation Bioprocess Engineering: Com alisation Energy and Enviromental Eng ergy ergy ergy ergy ergy ergy ergy erg	lsory npulsory jineering: Compulsor	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Bio General Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Biogram (General Engineering Science (English program): Specialisation (General Engineering Science (English program)): Specialisation (General Engineering Science (English Engine	process Engineering: Compulsory ergy and Enviromental Engineering: Co alisation Process Engineering: Compul alisation Bioprocess Engineering: Com alisation Energy and Enviromental Eng ergy ergy and Enviromental Engineering: Co	lsory npulsory jineering: Compulsor	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Brogram (General Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Engineering Science (English Prog	process Engineering: Compulsory ergy and Enviromental Engineering: Co alisation Process Engineering: Compul alisation Bioprocess Engineering: Compul alisation Energy and Enviromental Eng sory process Engineering: Compulsory rgy and Enviromental Engineering: Co sess Engineering: Compulsory	Isory Ipulsory Ijineering: Compulsor Impulsory	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Brogram (General Engineering Science (German program): Specialisation Engineerial Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special General Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compuls General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Engineerial Engineering Science (English program): Specialisation Program (General Engineering Science (English program): Specialisation (Gene	process Engineering: Compulsory ergy and Enviromental Engineering: Cor alisation Process Engineering: Compul alisation Bioprocess Engineering: Compul alisation Energy and Enviromental Engineering cory process Engineering: Compulsory rgy and Enviromental Engineering: Co pass Engineering: Compulsory tisation Process Engineering: Compul tisation Process Engineering: Compul	Isory Ipulsory Ipineering: Compulsor Impulsory Ipineering: Sompulsor	у
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Brogram (General Engineering Science (German program): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisoprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsing General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Engineerial Engineering Science (English program): Specialisation Programal Engineering Science (English program): Specialisation Programalisation Programalisation Engineering Science (English program): Specialisation Engineering Science (English program): Specialisation Programalisation Engineering Science (English program): Specialisation Engineering Science (English program): Specialisati	process Engineering: Compulsory ergy and Enviromental Engineering: Cor alisation Process Engineering: Compul alisation Bioprocess Engineering: Compul alisation Energy and Enviromental Eng ergy ergy ergy and Enviromental Engineering: Cor ess Engineering: Compulsory rgy and Enviromental Engineering: Cor ess Engineering: Compulsory ulisation Process Engineering: Compul lisation Bioprocess Engineering: Compul lisation Bioprocess Engineering: Compul lisation Bioprocess Engineering: Compul lisation Bioprocess Engineering: Compul	Isory ipulsory gineering: Compulsor mpulsory sory pulsory	
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Brogeneral Engineering Science (German program): Specialisation Engeneral Engineering Science (German program, 7 semester): Specialisation Engeneral Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisoprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsing General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Engineerial Engineering Science (English program, 7 semester): Specialised General Engineering Science (English program, 7 semester): Specialisering Science (English program, 7 seme	process Engineering: Compulsory ergy and Enviromental Engineering: Cor alisation Process Engineering: Compul alisation Bioprocess Engineering: Compul alisation Energy and Enviromental Engineering: Compulsory ergy and Enviromental Engineering: Compulsory ulisation Process Engineering: Compul- ulisation Bioprocess Engineering: Compul- ulisation Bioprocess Engineering: Compul- ulisation Energy and Enviromental Engineering: Engineering: Compul- ulisation Energy and Enviromental Engineering: Engineering: Compul- ulisation Energy and Enviromental Engineering: Engi	Isory ipulsory gineering: Compulsor mpulsory sory pulsory	
Examination Examination duration and scale Assignment for the Following	Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Program (General Engineering Science (German program): Specialisation Brogram (General Engineering Science (German program): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering Science (German program, 7 semester): Specialisation Engineerial Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsing General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Engineerial Engineering Science (English program, 7 semester): Special General Engineering Science (English program, 7 semester): Special Scie	process Engineering: Compulsory ergy and Enviromental Engineering: Cor alisation Process Engineering: Compul alisation Bioprocess Engineering: Compul alisation Energy and Enviromental Engineering: Compulsory ergy and Enviromental Engineering: Compulsory ulisation Process Engineering: Compul- ulisation Bioprocess Engineering: Compul- ulisation Bioprocess Engineering: Compul- ulisation Energy and Enviromental Engineering: Engineering: Compul- ulisation Energy and Enviromental Engineering: Engineering: Compul- ulisation Energy and Enviromental Engineering: Engi	Isory ipulsory gineering: Compulsor mpulsory sory pulsory	



Course L0101: Heat and Mass Transfer	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas

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

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



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	2	2
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge	The students can distinguish and describe different types of the students develop an understanding for the course of process, the possibilities of energy saving, and the selection. They have good knowledge of designing methods for separate	concentration during a separation proce on of separation systems		
Skills	Using the gained knowledge the students can select a reasonable system boundary for a given separation process and can close the associate energy and material balances The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages require They can select and design a basic type of thermal separation process for a given case based on the advantages and disadvantages of process The students are capable to obtain independently the needed material properties from appropriate sources (diagrams and tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab work. The students are able to discuss the theoretical background and the content of the experimental work with the teachers in colloquium. The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problem. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.		oretical stages required and disadvantages of the disadvantages of the disadvantages.	
Personal Competence Social Competence	The students can work technical assignments in small gro The students are able to carry out practical lab work in sn			n them. They are able to
	discuss their results and to document them scientifically in		Sion of labor betwee	ir triom. They are able to
	discuss their results and to desament them esterningary in	и гороги		
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 96, Study Time in Lecture 84			
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 I	Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation I			
	General Engineering Science (German program): Specialisation I		ompulsory	
	General Engineering Science (German program, 7 semester): Spo			
	General Engineering Science (German program, 7 semester): Spi			
	General Engineering Science (German program, 7 semester): Spi			у
	Bioprocess Engineering: Core qualification: Compulsory	and and and and and and	,	•
	Energy and Environmental Engineering: Core qualification: Comp	ulsorv		
	General Engineering Science (English program): Specialisation E	•		
	General Engineering Science (English program): Specialisation E		mnulsory	
			привогу	
	General Engineering Science (English program): Specialisation F		conv	
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe	olansation Energy and Enviromental Engi	meening: Compuisor)	1
	Process Engineering: Core qualification: Compulsory			



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 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 Enzyklopādie der Technischen Chemie



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



Course L0141: Thermal Separation	Processes
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie



Course L1159: Separation Processe	es
Тур	Laboratory Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Compulsory attendence of the colloquia of all experiments and compulsory report.
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	SoSe
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which th
	students explain and discuss the theoretical background and its translation into practice with staff and fellow students.
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions i terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.
	Topics of the practical course:
	 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. Steinkop 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' Enzyklopädie der Technischen Chemie



Module M0892: Chemical R	eaction Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fundamentals) (L0204)		Lecture	2	2
Chemical Reaction Engineering (Fundame	ntals) (L0244)	Recitation Section (large)	2	2
Experimental Course Chemical Engineering	ngineering (Fundamentals) (L0221) Laboratory Course 2 2			2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules mathematics I-III, phy	ysical chemistry, technical thermodynamics I+II as v	vell as computational r	nethods for engineers.
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of che	emical reaction engineering. They are able to point	out differences betwe	en thermodynamical and
	kinetical processes. The students have a strong ability	to outline parts of isothermal and non-isothermal id	eal reactors and to de	scribe their properties.
Skills	After successful completion of the module, students are	e able to:		
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,			
	app. James and the second seco			
	- determine and compute stable operation points for these reactors ,			
	- conduct experiments on a lab-scale pilot plants and d	ocument these according to scientific guidelines.		
Personal Competence				
Social Competence	After successful completition of the lab-course the stu	udents have a strong ability to organize themselfe	es in small groups to	solve issues in chemica
	reaction engineering. The students can discuss their su	ubject related knowledge among each other and wi	th their teachers.	
Autonomy	The students are able to obtain further information ar	nd 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): Spec	cialisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Spec			
	General Engineering Science (German program, 7 sen	nester): Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 sen	nester): Specialisation Bioprocess Engineering: Co	mpulsory	
	Bioprocess Engineering: Core qualification: Compulso	ry		
	General Engineering Science (English program): Spec	ialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Spec	ialisation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 sem	nester): Specialisation Process Engineering: Compr	ulsory	
	General Engineering Science (English program, 7 sem	nester): Specialisation Bioprocess Engineering: Con	mpulsory	
	Process Engineering: Core qualification: Compulsory			

Course L0204: Chemical Reaction E	ingineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors



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

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

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

Literature

lecture notes Raimund Horn

skript Frerich Keil

Books:

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- $\hbox{H.\,S.\,Fogler,\,Essentials\,of\,Chemical\,\,Reaction\,\,Engineering,\,Prentice\,\,Hall}$
- O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
- $\hbox{M.\,E.\,Davis,\,R.\,J.\,Davis,\,Fundamentals\,of\,Chemical\,\,Reaction\,\,Engineering,\,McGraw\,\,Hill}$
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



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 DE	
Language	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 coefficient 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 medicorkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy as 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-ist reactors, optimum temperature profile of a reactor)	
Literature	lecture notes Raimund Horn	
	skript Frerich Keil	
	Books:	
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH	
	G. Emig, E. Klemm, Technische Chemie, Springer	
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie	
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag	
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH	
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B	
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall	
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998	
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009	
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker	
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000	
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill	
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010	
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH	



Course L0221: Experimental Course	e Chemical Engineering (Fundamentals)
Тур	Laboratory Course
Hrs/wk	2
СР	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)



Typ Lecture Recitation Section (small) ing results I substrate-uptake cultivation of microorganisms and r	Hrs/wk 2 2	CP 4 2
Lecture Recitation Section (small)	2	4
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cultivation of microorganisms and r		
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ns and their application as well as b	asic immobilization m	nethods
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- To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganism and to the total fermentation process qualitatively		
on the kinetic parameters of differen	at approaches and to	calculate immebiliza
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rces of knowledge and apply their	knowledge to previou	usly unknown issues
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ation Bioprocess Engineering: Com	npulsory	
r r r	reactors and processes and to apple anological production processes appeared to equivalents, and the grown are the kinetic parameters of different propriately and to calculate basic type technical questions in small teams arces of knowledge and apply their process Engineering: Compulsory sation Bioprocess Engineering: Compulsory seation Bioprocess Engineering: Compulsory	ne the kinetic parameters of different approaches and to ropriately and to calculate basic types and evaluate then technical questions in small teams to enhance the ability arces of knowledge and apply their knowledge to previous possess Engineering: Compulsory sation Bioprocess Engineering: Compulsory into Bioprocess Engine



Course L1107: Bioprocess Engineering - Advanced		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese, Dr. Wael Sabra	
Language	DE	
Cycle	WiSe	
Content	 Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese) Enzymatic process II (Prof. Liese) Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese) Anaerobic fermentation processes (Prof. Zeng) Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng) Fedbatch process and cultivation with high cell density (Prof. Zeng) Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese) Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng) Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng) 	
Literature	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 Skripte für die Vorlesung	

Course L1108: Bioprocess Enginee	ring - Advanced	
Тур	Recitation Section (small)	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese	
Language	DE	
Cycle	WiSe	
Content	 Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese) Enzymatic process II (Prof. Liese) Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese) Anaerobic fermentation processes (Prof. Zeng) Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng) Fedbatch process and cultivation with high cell density (Prof. Zeng) Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese) Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng) Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng) The students present exercises and discuss them with their fellow students and faculty statt. In the PBL part of the class the students discuss scientific questions in teams. They acquire knowledge and apply it to unknown questions, present their results and argue their opinions.	
Literature	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioproze 8technik, 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	



Modulo M0520, Process on	d Plant Engineering I			
Module M0539: Process an	a 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	learning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical proces	sses		
	specify linear component equations of complex chemical processe	S		
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	- formulation of mass and energy balance equations and estimation	n of product streams		
	- estimation of component streams of chemical plants using linear of	component balance models		
	- solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of production	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 P	rocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation B	oprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Spe	cialisation Process Engineering: Compu	Isory	
	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: Elective Co	mpulsory
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bi	oprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Pr	ocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spec	sialisation Process Engineering: Compul	sory	
	General Engineering Science (English program, 7 semester): Spec	sialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): Spec	ialisation 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
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

Experimental process development

Reactor synthesis

Decision levels

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

G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19

G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306

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

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

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

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

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

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

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

J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002

J. Krekel, G. Siekmann, 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 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	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			
	 name and explain processes and unit-operations of solids p 	rocess engineering		
	characterize particles, particle distributions and to discuss the characterize particles.			
Skills	Students are able to			
	choose and design apparatuses and processes for solids processes.		ds properties of the pro	oduct
	asses solids with respect to their behavior in solids processing decument their work spiciality.	ig 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	Students are able to analyze and solve questions regarding solid pa	rticles independently.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation 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): Spec	alisation Process Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Spec	, , , ,		
	General Engineering Science (German program, 7 semester): Spec	alisation Energy and Enviromental E	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compul	•		
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program): Specialisation Eng		Compulsory	
	General Engineering Science (English program): Specialisation Pro		ulaan.	
	General Engineering Science (English program, 7 semester): Speci		•	
	General Engineering Science (English program, 7 semester): Speci	, , ,		,
	General Engineering Science (English program, 7 semester): Speci Process Engineering: Core qualification: Compulsory	ansanon Energy and Environmental Er	igineening. Compuisory	,
	Frocess Engineering. Core quantication: Compulsory			



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

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

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



Specialization Electrical Engineering

Module M0708: Electrical E	ngineering III: Circuit Theory and Transients			
•				
Courses				
Title		Тур	Hrs/wk	CP
Circuit Theory (L0566)		Lecture Regitation Section (amall)	3	4
Circuit Theory (L0567)	Prof. Arne Jacob	Recitation Section (small)	2	2
Module Responsible Admission Requirements	none			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge	Electrical Engineering Fana II, Mathematics Fana II			
· · · · · · · · · · · · · · · · · · ·				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating electrica	I circuits. They know the Fourier serie	s analysis of linea	r networks driven by
	periodic signals. They know the methods for transient analysis of linear			-
	frequency behaviour and the synthesis of passive two-terminal-circuits.			
Skills	The students are able to calculate currents and voltages in linear network	ks by means of basic methods, also wh	en driven by perio	dic signals. They are
	able to calculate transients in electrical circuits in time and frequency dom	ain and are able to explain the respecti	ve transient behav	iour. They are able to
	analyse and to synthesize the frequency behaviour of passive two-terminal	d-circuits.		
Personal Competence				
Social Competence	Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within the group.			
Autonomy	The students are able to find out the required methods for solving the give			
	lectures continuously by means of short-time tests. This allows them to		i objectives. They	can link their gained
	knowledge to other courses like Electrical Engineering I and Mathematics	i.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrica	Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Mechani	cal Engineering, Focus Mechatronics: 0	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisati	on Mechanical Engineering, Focus Me	chatronics: Compu	Isory
	General Engineering Science (German program, 7 semester): Specialisation	on Electrical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Electrical			
	General Engineering Science (English program): Specialisation Mechanic			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation			
	Computational Science and Engineering: Specialisation Engineering Science	ences: Elective Compulsory		
	Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Con	nouleary		
	Technomathematics: Specialisation III. Engineering Science: Elective Con- Technomathematics: Specialisation III. Engineering Science: Elective Con-			
	. 333			



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

Course L0567: Circuit Theory		
Тур	Recitation Section (small)	
Hrs/wk	2	
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	



Module M0567: Theoretical	Electrical Engineering I: Time-Independent Fie	lds		
Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I: Time-	Independent Fields (L0180)	Lecture	3	5
Theoretical Electrical Engineering I: Time-	Independent Fields (L0181)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathematik II, Ma	athematik III		
Recommended Previous Knowledge	Basic principles of electrical engineering and advanced mathem	atics		
Educational Objectives	After taking part successfully, students have reached the followin	g 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 of 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 problems			escribe the properties of ns for the theory of time-
	Furthermore, they are capable of applying a variety of methods assess the principal effects of given time-independent sources or characterization of electrostatic, magnetostatic, and electrical flot them for practical applications.	that require solving Maxwell's Equations fields and analyze these quantitatively.	for more general pro They can deduce mea	blems. The students can uningful quantities for the
Personal Competence				
Social Competence	Students are able to work together on subject related tasks in sessions).	small groups. They are able to presen	t their results effective	ely (e.g. during exercise
Autonomy	Students are capable to gather necessary information from prove reflect their knowledge by means of activities that accompany the the exam. Based on respective feedback, students are expected their knowledge obtained in this lecture and the content of other large.	e lecture, such as short oral quizzes durin to adjust their individual learning proces	g the lectures and exess. They are able to dra	ercises that are related to aw 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			
Assignment for the Following	General Engineering Science (German program): Specialisation	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Sp	pecialisation Electrical Engineering: Com	oulsory	
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Engineering: Comp	ulsory	
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		



Course L0180: Theoretical Electrical	Il Engineering I: Time-Independent 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	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", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Course L0181: Theoretical Electrical	I 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
	SoSe
Content	- Maxwell's Equations in integral and differential notation
	- Boundary conditions
	- Laws of conservation for energy and charge
	- Classification of electromagnetic field properties
	- Integral characteristics of time-independent fields (R, L, C)
	- Generic approaches to solving Poisson's Equation
	- Electrostatic fields and specific methods of solving
	- Magnetostatic fields and specific methods of solving
	- Fields of electrical current density and specific methods of solving
	- Action of force within time-independent fields
	- Numerical methods for solving time-independent problems
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M0748: Materials in	Electrical Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Electrotechnical Experiments (L0714)		Lecture	1	1
Materials in Electrical Engineering (L0685)		Lecture	2	3
Materials in Electrical Engineering (Problem	n 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 le	earning results		
Professional Competence				
Knowledge	Students can explain the composition and the structural properties mechanical, electrical, thermal, dielectric, magnetic and chemical pr	-	-	•
Skills	Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solutions and judge factors influential on the performance of materials in electrical engineering applications.			
Personal Competence Social Competence	Students can jointly solve subject related problems in groups. The course.	ey can present their results effectivel	y within the framewor	k of the problem solving
Autonomy	Students are capable to extract relevant information from the provi- reflect their acquired level of expertise with the help of lecture acconnect 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 Ele	ectrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spec	ialisation Electrical Engineering: Com	pulsory	
	Electrical Engineering: Core qualification: Compulsory	•		
	General Engineering Science (English program): Specialisation Ele	ctrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Speci		oulsory	
	Computational Science and Engineering: Specialisation Engineerin		•	
	Computational Science and Engineering: Specialisation Engineerin	g Sciences: Elective Compulsory		



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



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



ourses				
le		Тур	Hrs/wk	СР
nals and Systems (L0432)		Lecture	3	4
nals 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	stems. 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 following	wing learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and li			
	to apply the fundamental transformations of continuous-time			
	and systems mathematically in both time and image domain		in time domain and in	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		ponse, 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): Specialisa	tion Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa	tion Computer Science: Compulsory		
	General Engineering Science (German program): Specialisa	tion Process Engineering: Compulsory		
	General Engineering Science (German program): Specialisa	tion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisa	tion Civil- and Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisa	tion Mechanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisa	tion Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester)	: Specialisation Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester)	: Specialisation Process Engineering: Compu	ılsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering, Foo	cus Biomechanics: Co	mpulsory
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering, Foo	cus Energy Systems: 0	Compulsory
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compuls
	General Engineering Science (German program, 7 semes	ster): Specialisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engineering, Foo	cus Mechatronics: Cor	npulsory
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engineering	, Focus Theoretical M	Mechanical Enginee
	Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisat		mpulsory	
	General Engineering Science (English program): Specialisat			
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	General Engineering Science (English program, 7 semester)			
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engineering	J, ⊢ocus Materials in	∟ngineering Scier
	Compulsory Conoral Engineering Science (English program 7 competer)	Specialization Machanical Engineering Fra	us Moskatranias O	anulcon.
	General Engineering Science (English program, 7 semester)			
	General Engineering Science (English program, 7 semest	er). opecialisation iviechanical Engineering.	, rocus ineoretical N	леснанісаі Enginee
	Compulsory Computational Science and Engineering: Core qualification:	Compulsory		



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals and Systems	S
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle 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,	Computer Science Mathematics (L0571)	Seminar	2 2	2
Transmission Line Theory (L0570)	competer concrete, mathematics (2007.7)	Lecture	2	3
Transmission Line Theory (L0572)		Recitation Section (large)	2	1
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I-III, Mathematics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can explain the fundamentals of wave pro	pagation 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	ney can describe simple equivalent circuits of tran	smission lines. They ar	re able to solve problems
	with coupled transmission lines. They can present an	d 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	ze equivalent circuits of transmission lines. They	are able to solve pro	blems including coupled
	transmission lines using the vectorial transmission lir	e equations. They are able to give a talk to profess	ionals.	
Personal Competence				
Social Competence	Students can analyze and solve problems in small	groups 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 present a research topic to professionals and discuss it with them.			
Autonomy	The students can solve problems by their own and	are able to acquire skills from the lecture and the	literature. They are ab	le to test their knowledge
	using computer animations. They can test their level	of knowledge by answering short questions and tes	its during the lecture. Th	ney are able to relate their
	using computer animations. They can test their level of knowledge by answering short questions and tests during the lecture. They are able to relate their acquired knowledge to other lectures (e.g. Electrical Engineering I-III and Mathematics I-III). They can familiarize themselves with a research topic and			
	can prepare a presentation.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8-	4		
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following	General Engineering Science (German program): Sp	ecialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Electrical Engineering: Co	mpulsory	
	Electrical Engineering: Core qualification: Compulso	у		
	General Engineering Science (English program): Spe	ecialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 se	mester): Specialisation Electrical Engineering: Cor	npulsory	
	Computational Science and Engineering: Specialisate			
	Technomathematics: Specialisation III. Engineering S	· · ·		
	Technomathematics: Core qualification: Elective Con	npulsory		

Course L0571: Research Seminar Electrical Engineering, Computer Science, Mathematics	
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des SD E
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			
СР	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	Typ Hrs/wk CP
Electrical Engineering Project Laboratory (Lo640) Laboratory Course 5 6
Module Responsible	Prof. Christian Becker
Admission Requirements	None
Recommended Previous	Electrical Engineering I, Electrical Engineering II
Knowledge	
Education of Objections	Affects Consider the state of t
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate respective relationships. The
	are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
	process of solving practical problems and present related results.
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems. They identify an
Skills	overcome typical problems during the realization of projects in the context of electrical engineering. Students are able to develop, compare, and choos
	conceptual solutions for non-standardized problems.
	obitopida bolatono lo non danda di bol problemo.
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of electrical
,,,,,	engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability t
	develop alternative approaches to an electrical engineering problem independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as exter
	their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems an
	pragmatically solve them by means of corresponding solutions and concepts.
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): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Technomathematics: Core qualification: Elective Compulsory

Course L0640: Electrical Engineering Project Laboratory				
Тур	Laboratory Course			
Hrs/wk	5			
CP	6			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Lecturer	Prof. Christian Becker, Dozenten des SD E			
Language	DE			
Cycle	SoSe			
Content	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.			
Literature	Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).			



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				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					
	After telice and account the state of the	- fallancia a la ancia a				
Educational Objectives	After taking part successfully, students have reached the	e following learning i	esults			
Professional Competence						
Knowledge	Students can name the basic concepts in Mather	matice IV. They are a	hle to evolain them using ann	ronriate evamples		
	·				4h 4h a h a h a af a	
	Students can discuss logical connections between		rriey are capable of illustrating	litese confiections wi	un une neip 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.					
	 Students are able to discover and verify further lo 	ogical connections b	etween the concepts studied in	n the course.		
	 For a given problem, the students can develop a 	nd execute a suitabl	e approach, and are able to cri	itically evaluate the re	sults.	
Paragnal Compatons						
Personal Competence						
Social Competence	Students are able to work together in teams. The	ev are canable to use	mathematics as a common la	nguage		
	In doing so, they can communicate new concep				can docian evample	
			needs of their cooperating par	mers. Moreover, mey	can design example	
	check and deepen the understanding of their per	ers.				
Autonomy						
	Students are capable of checking their understa	anding of complex c	oncepts on their own. They ca	an specify open quest	ions precisely and kr	
	where to get help in solving them.					
	 Students have developed sufficient persistence t 	to be able to work fo	r longer periods in a goal-orien	ited manner on hard p	roblems.	
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112					
Credit points	6					
Examination	Written exam					
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential 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	ialisation Naval Arch	itecture: Compulsory			
	General Engineering Science (German program, 7 semi	ester): Specialisation	n Electrical Engineering: Comp	oulsory		
	General Engineering Science (German program, 7 semi			•	mpulsorv	
	General Engineering Science (German program, 7 se					
		emester). Opeoidise	tion weenamear Engineering	, roods medicadari	nconamoar Engineer	
	Compulsory					
	General Engineering Science (German program, 7 seme		•	ury		
	Computer Science: Specialisation Computational Mathe	ematics: Elective Co	mpulsory			
	Electrical Engineering: Core qualification: Compulsory					
	General Engineering Science (English program): Specia	alisation Electrical E	ngineering: Compulsory			
	General Engineering Science (English program): Specia	alisation Naval Arch	tecture: 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 Electrical Engineering: Compulsory					
					nuleon	
	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	n Engineering Scien	ces: Elective Compulsory			
	Computational Science and Engineering: Specialisation					
	Mechanical Engineering: Specialisation Theoretical Mechanical	·				
	, , , , , , , , , , , , , , , , , , ,	-	g. Compuisory			
	Mechanical Engineering: Specialisation Mechatronics: 0	Compulsory				
	Mechatronics: Core qualification: Compulsory					
	Naval Architecture: Core qualification: Compulsory					
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory					



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

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

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



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

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



Module M0675: Introduction	n to Communications and Random Processes				
Courses					
Title	Тур	Hrs/wk	СР		
Introduction to Communications and Rand	Lecture	3	4		
Introduction to Communications and Rand	om Processes (L0443)	Recitation Section (large)	1	2	
Module Responsible	Prof. Gerhard Bauch				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics 1-3 Signals and Systems Basic knowledge of probability theory				
Educational Objectives	After taking part successfully, students have reached the following	learning results			
Professional Competence					
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual buildin blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources an evaluation criteria of information transmission and are able to design and evaluate a basic communications system.			-	
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or be 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 appropriate literature sources. They can control their level of knowledge during the lectur 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, 7 semester): Specialisation Electrical Engineering: Compulsory				
	Computer Science: Specialisation Computer and Software Engine	eering: Elective Compulsory			
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation E				
	General Engineering Science (English program, 7 semester): Spe		pulsory		
	Computational Science and Engineering: Specialisation Enginee Technomathematics: Specialisation III. Engineering Science: Elec				
	Technomathematics: Specialisation III. Engineering Science: Electromathematics: Core qualification: Elective Compulsory	aive Compuisory			
	100/momationatios. Oure qualification. Liective Compulsory				



Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	WiSe
Content	Fundamentals of random processes
	Introduction to communications engineering
	Quadrature amplitude modulation
	Description of radio frequency transmission in the equivalent complex baseband
	Transmission channels, channel models
	Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)
	Fundamentals of information theory, source coding, channel coding
	Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
	Fundamentals of digital modulation
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner
	P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
	M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
	S. Haykin: Communication Systems. Wiley
	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Course L0443: Introduction 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	



Courses				
Γitle		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, The	eoretical Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, Mathe			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	5 p	3 3		
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They ca 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 can assess the principal effects of given time-depent the characterization of fully dynamic fields (wave important to practical applications.	dent sources of fields and analyze these quantitat	ively. They can deduce	meaningful quantities
Personal Competence Social Competence	Students are able to work together on subject rela sessions).	ted tasks in small groups. They are able to pres	ent their results effectiv	rely (e.g. during exerc
Autonomy	Students are capable to gather necessary informative reflect their knowledge by means of activities that act the exam. Based on respective feedback, students a acquired knowledge and ongoing research at the Ha	company the lecture, such as short oral quizzes du re expected to adjust their individual learning proc	ring the lectures and exess. They are able to di	ercises that are related raw 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			
Assignment for the Following	General Engineering Science (German program): Sp	ecialisation Electrical Engineering: Compulsorv		
Curricula	General Engineering Science (German program, 7 s		mpulsory	
	Electrical Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Sp	•		
	General Engineering Science (English program, 7 se		mpulsory	
	Technomathematics: Specialisation III. Engineering 9		•	



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
- 0	DE .
Cycle	WiSe
Content	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Course L0183: Theoretical Electrical	al Engineering II: Time-Dependent Fields
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Schuster
Language	DE
Cycle	WiSe
Content	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M0783: Measureme	ents: Methods and Data Processing				
Courses					
Title		Тур	H	lrs/wk	CP
EE Experimental Lab (L0781)		Laboratory Cours			2
Measurements: Methods and Data Proces	= ' '	Lecture	2		3
Measurements: Methods and Data Proces		Recitation Section	n (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 reach	ed the following learning results			
Professional Competence					
Knowledge	The students are able to explain the purpose of m	netrology and the acquisition and process	sing of measurements. T	They can det	ail aspects of probabilit
	theory and errors, and explain the processing of st	ochastic signals. Students know methods	to digitalize and describ	e measured	signals.
Skills	The students are able to evaluate problems of met	rology and to apply methods for describin	g and processing of mea	asurements.	
Personal Competence					
Social Competence	The students solve problems in small groups.				
Autonomy	The students can reflect their knowledge and discu	you and avaluate their regults			
Autonomy	The students can reflect their knowledge and discu	iss and evaluate their results.			
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70			
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following	General Engineering Science (German program):				
Curricula	General Engineering Science (German program, 7			ulsory	
	Computer Science: Specialisation Computer and S		У		
	Electrical Engineering: Core qualification: Compul				
	General Engineering Science (English program):				
	General Engineering Science (English program, 7			ilsory	
	Computational Science and Engineering: Speciali				
	Computational Science and Engineering: Speciali		ulsory		
	Technomathematics: Specialisation III. Engineerin	• • •			
	Technomathematics: Core qualification: Elective C	Compulsory			

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	
СР	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 I	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 E	ectrical Engineering or courses with e	quivalent contents	
	Cassossial participation of Thysics in Engineers and Materials in E	Couldar Engineering of Courses with C	quivalent contents	
Educational Objectives	After taking part successfully, students have reached the following leading to the following lea	earning results		
Professional Competence				
Knowledge				
	Students are able			
	to represent the basics of semiconductor physics,			
	to explain the operating principle of important semiconducto	devices,		
	to outline device characteristics and equivalent circuits as w	ell as to explain their derivation and		
	to discuss the limitation of device models.			
0.11				
Skills				
	Students are capable			
	 to apply devices in basic circuits, 			
	to apply devices in basis should,			
	to realize the physical context and to solve complex problem	s by oneself		
Barra and Com.				
Personal Competence	Students are able to proper and perform their leb	am work on wall on to propert and die	auga the regulte is for the	of audionos
Social Competence	Students are able to prepare and perform their lab experiments in to	am work as well as to present and dis	cuss the results in front	oi audience.
Autonomy	Students are capable to acquire knowledge based on literature in o	rder 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 Ele			
Curricula	General Engineering Science (German program, 7 semester): Spec	ialisation Electrical Engineering: Com	pulsory	
	Electrical Engineering: Core qualification: Compulsory	and a life of the same of the same of		
	General Engineering Science (English program): Specialisation Ele		vulaanu	
	General Engineering Science (English program, 7 semester): Speci	alisation Electrical Engineering: Comp	ouisory	



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	 Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor equations) pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode) Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor) Unipolar devices (surface effects: surface states, work function, energy band diagram; metal-semiconductor junctions: Schottky contact, current-voltage characteristics, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MESFET: operating principle, depletion mode and enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics, frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS)
Literature	S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011)
	T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004)
	B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005)
	D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011)
	M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996)
	S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007)
	H. Schaumburg: Halbleiter, B.G. Teubner (1991)
	A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992)
	HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

Course L0721: Electronic 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				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L0763)		Lecture	3	4
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge				
3	Students are able to explain the functionality of different	MOS devices in electronic circuits.		
	Students know the fundamental digital logic circuits and	can discuss their advantages and disadva	ntages.	
	 Students have solid knowledge about memory circuits a 	nd can explain their functionality and speci	fications.	
	 Students are able to explain how analog circuits function 	ns and where they are applied.		
	Students know the appropriate fields for the use of bipole	ar transistors.		
Skills	Students can calculate the specifications of different MO	S devices and can define the parameters of	of electronic circuits	
	Students are able to develop different logic circuits and develop different logic circuits and develop different logic circuits.		r cicolionio direane.	
	Students are able to develop different rogic directlis and to Students can use MOS devices, operational amplifiers a		ine	
	Students can use woo devices, operational ampliners a	nd bipotat transistors for specific application	1115.	
Personal Competence Social Competence	Students are able work efficiently in heterogeneous tear	ns.		
	Students working together in small groups can solve pro			
Autonomy	Students are able to assess their level of knowledge.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (German program, 7 semester): S	Specialisation Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical Engineering, Foo	cus Mechatronics: Com	oulsory
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	n Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester): S			oulsory
	Mechanical Engineering: Specialisation Mechatronics: Compuls		- 1	-
	Mechatronics: Core qualification: Compulsory	-		
	Technomathematics: Core qualification: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		



Course L0763: Semiconductor Circu	uit Design
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	NN
Language	DE
Cycle	SoSe
Content	 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 From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).
Literature	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo



9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4	Course L0864: Semiconductor Circu	it Design
Workload in Hours Lacturer Language Cycle Sose Content Basic circuits with MOS transistors for logic gates and amplifiers Fipical 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 Operational amplifiers and their applications Basic circuits with bipolar transistors 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 ISBN: 9783642208867 URL: http://dx.doi.org/10.1007/978-3-642-20887-4	Тур	Recitation Section (small)
Independent Study Time 46, Study Time in Lecture 14 NN	Hrs/wk	1
Lecturer NN Language DE Cycle SoSe Content Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMCS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors 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, 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://dx.doi.org/10.1007/978-3-642-20887-4	CP	2
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 Operational amplifiers and their applications Basic circuits with bipolar transistors Operational amplifiers and their applications Basic circuits with bipolar transistors Usesign 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, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 978364220887 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499	Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
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, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499	Lecturer	NN
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 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 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 URL: http://site.ebrary.com/lib/allitides/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/allitides/docDetail.action?docID=10499499 URL: http://site.ebrary.com/lib/allitides/docDetail.action?docID=10499499	Cycle	SoSe SoSe
URL: http://ebooks.ciando.com/pook/index.ctm/bok_id/319955 URL: http://www.ciando.com/img/bo	Content	 Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 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



ourses	ns of Management			
le		Тур	Hrs/wk	СР
roduction to Management (L0880)		Lecture	3	3
pject Entrepreneurship (L0882)		Problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	Dasic Knowledge of Mathematics and Dusiness			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
	After taking part successionly, students have reached the following	learning results		
Professional Competence	After taking this module, students know the important basics of a	any different areas in Business and Mar	agament from Plan	ning and Organizatio
Knowledge	After taking this module, students know the important basics of m Marketing and Innovation, and also to Investment and Controlling.		iagement, irom Fiam	iiig and Organisand
	mandang and innovation, and also to investment and controlling.	in particular they are able to		
	 explain the differences between Economics and Manager 	ent and the sub-disciplines in Manageme	ent and to name impo	ortant definitions from
	field of Management			
	explain the most important aspects of and goals in Manage	ment and name the most important aspe	cts of entreprneurial p	orojects
	 describe and explain basic business functions as produce 	tion, procurement and sourcing, supply	chain management,	organization and hu
	ressource management, information management, innovation	ion management and marketing		
	explain the relevance of planning and decision making i	n Business, esp. in situations under mul	tiple objectives and	uncertainty, and exp
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected con	trolling methods.		
Skills	Students are able to analyse business units with respect to	o different criteria (organization, object	tives, strategies etc	.) and to carry out
	Entrepreneurship project in a team. In particular, they are able to	(ga,,	,	., 15 54, 55.
	analyse Management goals and structure them appropriate	ely		
	analyse organisational and staff structures of companies			
	 apply methods for decision making under multiple objective 	es, under uncertainty and under risk		
	 analyse production and procurement systems and Busines 	s information systems		
	 analyse and apply basic methods of marketing 			
	 select and apply basic methods from mathematical finance 	to predefined problems		
	apply basic methods from accounting, costing and controlling.	ng to predefined problems		
Personal Competence				
	Chudanta ava abla ta			
Social Competence	Students are able to			
	 work successfully in a team of students 			
	to apply their knowledge from the lecture to an entreprener	rship project and write a coherent report	on the project	
	to communicate appropriately and			
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program): Specialisation E	lectrical Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisation (Computer Science: Compulsory		
Assignment for the Following Curricula				
	General Engineering Science (German program): Specialisation F	Process Engineering: Compulsory		
	1	0 0 1 7		
	General Engineering Science (German program): Specialisation F	dioprocess Engineering: Compulsory	ompulsory	
	General Engineering Science (German program): Specialisation F General Engineering Science (German program): Specialisation E	dioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co		
	General Engineering Science (German program): Specialisation F General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation E	ioprocess Engineering: Compulsory inergy and Enviromental Engineering: Co ivil- and Enviromental Engeneering: Cor		
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	General Engineering Science (German program): Specialisation F General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation C General Engineering Science (German program): Specialisation M	tioprocess Engineering: Compulsory inergy and Enviromental Engineering: Co Sivil- and Enviromental Engeneering: Cor flechanical Engineering: Compulsory tiomedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation F General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation E General Engineering Science (German program): Specialisation O General Engineering Science (German program): Specialisation M General Engineering Science (German program): Specialisation E	tioprocess Engineering: Compulsory inergy and Environental Engineering: Conicional Environental Engeneering: Confectanical Engineering: Compulsory biomedical Engineering: Compulsory Laval Architecture: Compulsory	npulsory	
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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



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

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



Specialization Computer Science

Module M0561: Discrete Al	gebraic Structures			
Courses				
Title		Тур	Hrs/wk	CP
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	ing learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic	structures including elementary combinate	orial structures, mono	ids, groups, rings, fields,
	finite fields, and vector spaces. They also know specific structure	es like sub sum-, and quotient structures a	and homomorphisms.	
Skilla	Students are able to formalize and analyze basic discrete algel	araja atruaturas		
Skills	Students are able to formalize and analyze basic discrete alger	oraic structures.		
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a grou	and to present the results accordingly.		
Autonomy	Students are able to acquire new knowledge from specific stan	dard backs and to accomists the acquired k	nouladae te ether ele	
Autonomy	Students are able to acquire new knowledge from specific stan	dard books and to associate the acquired ki	nowledge to other cla	5585.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
· ·	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester):		orv	
Surreula	Computer Science: Core qualification: Compulsory	Specialisation computer colonies. Compute	·.,	
	General Engineering Science (English program): Specialisatio	n Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): S		orv	
	Computational Science and Engineering: Core qualification: C		- ,	
	Technomathematics: Specialisation I. Mathematics: Elective Co			
	recimoniatirematics. Specialisation i. Mathematics. Elective Co	ilipulsory		

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: Objectorien	ted Programming, Algorithms and D	Oata Structures		
Courses				
Title		Тур	Hrs/wk	СР
Objectoriented Programming, Algorithms a	and Data Structures (L0131)	Lecture	4	4
Objectoriented Programming, Algorithms a	and Data Structures (L0132)	Recitation Section (small)	1	2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended Previous	Lecture Prozedurale Programmierung or equivale	ent proficiency in imperative programming		
Knowledge	Mandatany proroquicito for this locture is proficio	ncy in imperative programming (C, Pascal, Fortran or si	milar). Vou should bo	familiar with simple d
		for, while, procedure calls or function calls, pointers, ar	*	•
		n editor, compiler, linker and debugger. In this lecture w	•	•
	objects and we will not repeat the basics mention		,	
		LUM because those prerequisites are not part of the cu		
	those curricula in general. The programs E1, C1a	nd IIW include those prerequisites in the first semester in	the lecture Prozedura	ale Programmierung.
= 1 1011				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	· ·	design and the design of a class architecture with re	ference to existing cl	ass libraries and des
	patterns.			
	Students can describe fundamental data structure	es of discrete mathematics and assess the complexity of	mportant algorithms fo	or sorting and searching
Skills	Students are able to			
	Design software using given design natter	rns and applying class hierarchies and polymorphism		
		using version management systems and Google Test		
	Sort and search for data efficiently			
	 Assess the complexity of algorithms. 			
Personal Competence				
Social Competence	Students can work in teams and communicate in	forums.		
Autonomy	Students are able to solve programming tasks su	ch as LZW data compression using SVN Repository and	d Google Test indeper	ndently and over a per
	of two to three weeks.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minutes, Content of Lecture, exercises and ma	terial in StudIP		
Assignment for the Following	General Engineering Science (German program)	: Specialisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program,	7 semester): Specialisation Computer Science: Computer	sory	
	Computer Science: Core qualification: Compulsor			
	Electrical Engineering: Core qualification: Compu			
	General Engineering Science (English program):			
		7 semester): Specialisation Computer Science: Compuls	ory	
	Computational Science and Engineering: Core qu			
	Logistics and Mobility: Specialisation Engineering			
	Technomathematics: Core qualification: Compuls	ory		



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

Course L0132: Objectoriented 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: Automata	Theory and Formal Languages			
Courses				
Title		Тур	Hrs/wk	CP
Automata Theory and Formal Languages	(L0332)	Lecture	2	4
Automata Theory and Formal Languages		Recitation Section (small)	2	2
Module Responsible	Prof. Tobias Knopp			
Admission Requirements	None			
Recommended Previous	Participating students should be able to			
Knowledge	- specify algorithms for simple data structures (such as, e.g., ar	rays) to solve computational problems		
	- apply propositional logic and predicate logic for specifying ar	nd understanding mathematical proofs		
	- apply the knowledge and skills taught in the module Discrete	Algebraic Structures		
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
	Students can show correspondences to Boolean algebra. Sti logic, and therefore, the students can motivate predicate logic Students can explain unification and resolution for solving the decision problems for various kinds of temporal logic, and ider automata and can identify relationships to logic and form nondeterministic finite automata and pushdown automata to expressive than determinism. They are also able to demons transform decision problems w.r.t. one formalism into decisio algorithms whereas others are best suited for specifying syste as logic, automata, or grammars.	c, and define syntax, semantics, and decisi predicate logic SAT decision problem. Stuc ntify their application areas. The participants al grammars. The spectrum that students Turing machines. Students can name those trate which decision problems require which problems w.r.t. other formalisms. They up	on problems for this re- dents can also describe s of the course can defi- can explain ranges e formalism for which in the expressivity, and, in inderstand that some for	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 for application problem, and they can demonstrate the application nondeterministic automata into deterministic ones, or derive gapply algorithms for the language emptiness problem in case of	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	Compulsory	
	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 C	Compulsory	
	Computational Science and Engineering: Core qualification: C			
	Technomathematics: Specialisation II. Informatics: Elective Co.	mpulsory		



Course L0332: Automata Theory and	d 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	
	1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
	Predicate logic, unification, predicate logic resolution
	3. Temporal Logics (LTL, CTL)
	Deterministic finite automata, definition and construction
	Regular languages, closure properties, word problem, string matching
	6. Nondeterministic automata:
	Rabin-Scott transformation of nondeterministic into deterministic automata
	7. Epsilon automata, minimization of automata,
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
	8. Myhill-Nerode Theorem:
	Correctness of the minimization procedure, equivalence classes of strings induced by automata
	9. Pumping Lemma for regular languages:
	provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive enough to solve a word
	problem for some given language
	10. Regular expressions vs. finite automata:
	Equivalence of formalisms, systematic transformation of representations, reductions 11. Pushdown automata and context-free grammars:
	Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping lemma for context-free
	grammars, transformation of formalisms (from pushdown automata to context-free grammars and back)
	12. Chomsky normal form
	13. CYK algorithm for deciding the word problem for context-free grammrs
	14. Deterministic pushdown automata
	15. Deterministic vs. nondeterministic pushdown automata:
	Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler
	16. Regular grammars
	17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars
	18. Chomsky hierarchy
	19. Mealy- and Moore automata:
	Automata with output (w/o accepting states), infinite state sequences, automata networks
	20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verification w.r.t. temporal logic
	specifications (in particular LTL)
	21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic
	22. Fixed points, propositional mu-calculus
	23. Characterization of regular languages by monadic second-order logic (MSO)
Literature	
Literature	Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.
	2. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006
	3. Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
	4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

Course L0507: 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



Courses				
Title		Тур	Hrs/wk	CP
signals and Systems (L0432)		Lecture	3	4
signals and Systems (L0433)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge				
	The modul is an introduction to the theory of signals and systems. Further experience with spectral transformations (Fourier series, Fourier series, Fourier series).			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear times	e-invariant (LTI) systems using metho	ds of signal and syste	em theory. They are a
	to apply the fundamental transformations of continuous-time and disc	crete-time signals and systems. They	an describe and anal	lyse deterministic sign
	and systems mathematically in both time and image domain. In pa	articular, they understand the effects	in time domain and i	mage domain which
	caused by the transition of a continuous-time signal to a discrete-time	e signal.		
Skills	The students are able to describe and analyse deterministic signals	and linear time-invariant systems usi	ng methods of signal	and system theory. T
	can analyse and design basic systems regarding important properti	es such as magnitude and phase res	oonse, stability, linear	rity etc They can ass
	the impact of LTI systems on the signal properties in time and freque	ncy domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from appropr	ate literature sources. They can cont	rol their level of know	rledge during the lec
	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		strical Engineering: Compulary		
Curricula	General Engineering Science (German program): Specialisation Ele General Engineering Science (German program): Specialisation Con			
Curricula	General Engineering Science (German program): Specialisation Pro			
	General Engineering Science (German program): Specialisation Fro			
	General Engineering Science (German program): Specialisation Sid		mnulsory	
	General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program, 7 semester): Speci		ulsory	
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci			
	General Engineering Science (German program, 7 semester): Speci			mpulsory
	General Engineering Science (German program, 7 semester): Speci-			
	General Engineering Science (German program, 7 semester): Speci	alisation Mechanical Engineering, Foo	cus Aircraft Systems E	ngineering: Compuls
	General Engineering Science (German program, 7 semester): Sp	pecialisation Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): Speci-	alisation Mechanical Engineering, Foo	us Mechatronics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineering	Focus Theoretical M	Mechanical Engineer
	Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civi	- and Enviromental Engeneering: Cor	mpulsory	
	General Engineering Science (English program): Specialisation Biop	process Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Elec	trical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Con	nputer Science: Compulsory		
	General Engineering Science (English program): Specialisation Med	hanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Bior	nedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Program	cess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Specia	lisation Electrical Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester): Specia	lisation Computer Science: Compulso	ory	
	General Engineering Science (English program, 7 semester): Specia		•	
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foc	us Aircraft Systems Er	ngineering: Compulso
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering	, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering	Focus Theoretical N	Mechanical Engineer
	Compulsory			
	Compulsory Computational Science and Engineering: Core qualification: Compu Mechatronics: Core qualification: Compulsory	sory		



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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



Module 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 None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	Sadio Midwidge of Mathematics and Eddiness
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 Organisatio 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
	field of Management
	 explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and hur
	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 exp
	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
	apply methods for decision making under multiple objectives, under uncertainty and under risk apply on production and programment evetoms and Business information systems.
	 analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
Social Competence	Siduents 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
	A work is a team and to arganize the team themselves
	 work in a team and to organize the team themselves to write a report on their project.
	to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Examination	Written exam
Examination duration and scale	90 minutes
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: Compuls
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineer



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

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



Module M0852: Graph Theo	ory and Optimization			
Courses				
Title Graph Theory and Optimization (L1046) Graph Theory and Optimization (L1047)		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Anusch Taraz	Hecitation Section (Smail)	2	3
Admission Requirements	none			
Recommended Previous	none			
Knowledge	Discrete Algebraic Structures Mathematics I			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence Knowledge	Students can name the basic concepts in Graph Theory a Students can discuss logical connections between these They know proof strategies and can reproduce them.			•
Skills	Students can model problems in Graph Theory and Optir of solving them by applying established methods. Students are able to discover and verify further logical co For a given problem, the students can develop and execu	nnections 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 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program, 7 semester): Sp	pecialisation Computer Science: Comput	sory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp		sory	
	Computational Science and Engineering: Core qualification: Cor	•		
	Logistics and Mobility: Specialisation Engineering Science: Elec Technomathematics: Specialisation I. Mathematics: Elective Con			
	recommendation attos. Opecianoation i. Mathematics. Elective Con	ipaiooi y		



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

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



urses				
e		Тур	Hrs/wk	CP
nerical Mathematics I (L0417) nerical Mathematics I (L0418)		Lecture Recitation Section (small)	2	3
	Prof. Sabine Le Borne	Heditation Section (Small)		3
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	 Mathematik I + II for Engineering Studen 	ıts (german or english) or Analysis & Linear Algebra I + I	l for Technomathematici	ans
Educational Objectives	After taking part successfully, students have rea	sched the following learning results		
Professional Competence				
Knowledge	Students are able to			
	· ·	ion, integration, least squares problems, eigenvalue p	roblems, nonlinear root	ifinding problems an
	explain their core ideas,			
	repeat convergence statements for the interest of the int			
	explain aspects for the practical execution	on of numerical methods with respect to computational a	nd storage complexitx.	
Skills	Students are able to			
	implement, apply and compare numeric	al methods using MATLAB,		
	justify the convergence behaviour of nu	merical methods with respect to the problem and solution	n algorithm,	
	select and execute a suitable solution a	pproach for a given problem.		
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously com	posed teams (i.e., teams from different study programs	and background knowle	edge), explain theore
	foundations and support each other with	n practical aspects regarding the implementation of algor	ithms.	
Autonomy	Students are capable			
	to assess whether the supporting theorem.	etical and practical excercises are better solved individua	ılly or in a team,	
	to assess their individual progess and, i	f necessary, to ask questions and seek help.		
Workload in Hours		cture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program	n): Specialisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program	n): Specialisation Mechanical Engineering, Focus Biome	chanics: Compulsory	
	General Engineering Science (German program	n): Specialisation Mechanical Engineering, Focus Mater	als in Engineering Scie	nces: Compulsory
	General Engineering Science (German program	n): Specialisation Biomedical Engineering: Compulsory		
		n, 7 semester): Specialisation Computer Science: Comp	•	
		ram, 7 semester): Specialisation Mechanical Enginee	ring, Focus Materials i	n Engineering Scien
	Compulsory			
		n, 7 semester): Specialisation Biomedical Engineering: (
		n, 7 semester): Specialisation Mechanical Engineering,	-ocus Biomechanics: Co	ompulsory
	, , ,	neral Bioprocess Engineering: Elective Compulsory		
	Computer Science: Specialisation Computation			
	Electrical Engineering: Core qualification: Elect	n): Specialisation Computer Science: Compulsory		
		n): Specialisation Biomedical Engineering: Compulsory n): Specialisation Mechanical Engineering, Focus Biome	chanics: Compulsors	
		, ,		nees Compulsory
		n): Specialisation Mechanical Engineering, Focus Materi n, 7 semester): Specialisation Computer Science: Compu		ices. Compulsory
		am, 7 semester): Specialisation Computer Science. Computer and the computer science and the comp	•	n Engineering Scion
	Compulsory	ani, / semester). Opecialisation Mechanical Enginee	mg, rocus materiais ii	Lugmeening oden
	, ,	n, 7 semester): Specialisation Biomedical Engineering: C	Compulsory	
	General Engineering Science (English program	1. / semester): Specialisation Mechanical Engineering F	ocus Biomechanics: Co	mpulsorv
	Computational Science and Engineering: Core	 n, 7 semester): Specialisation Mechanical Engineering, F qualification: Compulsory 	-ocus Biomechanics: Cc	ompulsory



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

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



Module M0793: Seminars C	Computer Science and Mathematics			
Courses				
Title		Тур	Hrs/wk	СР
Seminar Computational Mathematics/Computer Science (L0797)		Seminar	2	2
Seminar Computational Engineering Science (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 following learning results			
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a rudimentary field of Computer Science, Mathematics, or Engineering Science.			
Skills	The students are able to elaborate self-reliantly a rudimentary subfield of Computer Science, Mathematics, or Engineering Science.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Presentation			
Examination duration and scale	Pro Seminar erfolgt der Scheinerwerb durch Präsentation (S	Seminarvortrag 25 min und Diskussion 5	min)	
Assignment for the Following	General Engineering Science (German program): Specialisation Computer Science: Compulsory			
Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory			
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisa	tion Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Con	mpulsory	
	Computational Science and Engineering: Core qualification	: Compulsory		

Course L0797: Seminar Computation	onal 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	 Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics or computer science are proposed by the organizer Active participation in discussions.
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	 Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering science are proposed by the organizer Active participation in discussions. 	
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	 Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering mathematics are proposed by the organizer Active participation in discussions.
Literature	Wird vom Seminarveranstalter bekanntgegeben.



	and the second				
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	Basics of Computer Science				
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 Inte	ernet protocols in detail and classify them, in or	der to be able to analyse	and develop networked	
	systems in further studies and job.				
Chille					
Skills	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.				
Personal Competence					
Social Competence					
Autonomy	Students can select relevant parts out of high amount of professional knowledge and can independently learn and understand it.				
Autonomy	Students can select relevant parts out or night amount or	professional knowledge and can independently	y learn and understand it		
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): Speci	alisation Computer Science: Compulsory			
Curricula	General Engineering Science (German program, 7 seme	ester): Specialisation Computer Science: Electiv	ve Compulsory		
	Computer Science: Core qualification: Compulsory				
	Electrical Engineering: Core qualification: Elective Comp	oulsory			
	General Engineering Science (English program): Specia	alisation Computer Science: Compulsory			
	General Engineering Science (English program, 7 seme	ster): Specialisation Computer Science: Electiv	re Compulsory		
	Computational Science and Engineering: Core qualifica				
	Technomathematics: Specialisation II. Informatics: Electi				
	Technomathematics: Specialisation II. Informatics: Electi	ve Compulsory			

Course L1098: Computer Networks	and Internet Security
	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
Literature	 Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition
	Further literature is announced at the beginning of the lecture.



Course L1099: Computer 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	



Sule M0791: Computer And Sule M0791: Computer	cmiecture	Тур		
		Typ		
		Typ		
uter Architecture (L0793)			Hrs/wk	CP
		Lecture	nrs/wk 2	3
outer Architecture (L0794)		Problem-based Learning	2	2
uter Architecture (L1864)		Recitation Section (small)	1	1
	Prof. Heiko Falk	rissians. Section (emaily	•	•
Admission Requirements N	lone			
Recommended Previous M	Module "Computer Engineering"			
Knowledge				
Educational Objectives A	after taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge TI	his module presents advanced concepts from the discip	line of computer architecture. In the beginning	, a broad overview ov	rer various programming
m	models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the			ndational aspects of the
m	micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of			ed for the acceleration of
in	instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution o			
m	machine instructions and for memory hierarchies.			
Skills Ti	The students are able to describe the organization of proce	essors. They know the different architectural prin	ciples and programm	ing models. The students
	The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g.,			
	performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to			
i i	distinguish between instruction- and data-level parallelism.			
Personal Competence				
Social Competence S	students are able to solve similar problems alone or in a g	roup and to present the results accordingly.		
Autonomy S	Students are able to acquire new knowledge from specific	literature and to associate this knowledge with o	other classes.	
Workload in Hours In	ndependent Study Time 110, Study Time in Lecture 70			
Credit points 6				
Examination W	Vritten exam			
xamination duration and scale 9	0 minutes, contents of course and 4 attestations from the	PBL "Computer architecture"		
Assignment for the Following G	General Engineering Science (German program): Speciali	sation Computer Science: Compulsory		
Curricula G	General Engineering Science (German program, 7 semest	er): Specialisation Computer Science: Elective	Compulsory	
С	Computer Science: Specialisation Computer and Software	Engineering: Elective Compulsory		
G	General Engineering Science (English program): Specialis	sation Computer Science: Compulsory		
G	General Engineering Science (English program, 7 semeste	er): Specialisation Computer Science: Elective C	Compulsory	
С	Computational Science and Engineering: Specialisation C	omputer Science: Elective Compulsory		

Course L0793: Computer Architecto	
•	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	 Introduction VHDL Basics Programming Models Realization of Elementary Data Types Dynamic Scheduling Branch Prediction Superscalar Machines Memory Hierarchies The theoretical tutorials amplify the lecture's content by solving and discussing exercise sheets and thus serve as exam preparation. Practical aspects of computer architecture are taught in the FPGA-based PBL on computer architecture whose attendance is mandatory.
Literature	 D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.



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

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



Module M0731: Functional P				
Courses				
Title		Тур	Hrs/wk	CP
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 followi	ng learning results		
Professional Competence				
*	Students apply the principles, constructs, and simple design		•	•
l'	programs and to explain Haskell syntax as well as Haskell's re			
	fundamental data structures, data types, and type constructors.		ctions and simple pr	oof techniques for partial
	and total correctness. They distinguish laziness from other eval	uation strategies.		
Skills 5	Students break a natural-language description down in parts a	amenable to a formal specification and deve	elop a functional prog	ram in a structured way.
-	They assess different language constructs, make conscious s	elections both at specification and implement	entations level, and	justify their choice. They
ŧ	analyze given programs and rewrite them in a controlled way.	They design and implement unit tests and ca	an assess the quality	of their tests. They argue
f	for the correctness of their program.			
Personal Competence				
Social Competence	Students practice peer programming with varying peers. They explain problems and solutions to their peer. They defend their programs orally. They			
,	communicate in English.			, ., ., .,
Autonomy	In programming labs, students learn under supervision (a.k.a.	"Retreutes Programmieren") the mechanic	s of programming In	evercises they develon
*	solutions individually and independently, and receive feedback	- · · · · · · · · · · · · · · · · · · ·	o or programming. in	exciologo, they develop
	solutions marviating and macpendently, and receive lecablest	•		
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): Specialisatio	n Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S	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): S	pecialisation Computer Science: Elective Co	ompulsory	
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory			
-	Technomathematics: Specialisation II. Informatics: Elective Com	npulsory		

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



Course L0625: Functional Programming		
Тур	Recitation Section (large)	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Schupp	
Language	EN	
Cycle	WiSe	
Content	 Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics 	
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.	

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



Module M0727: Stochastics	s			
Courses				
Title		Тур	Hrs/wk	CP
Stochastics (L0777)		Lecture	2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	none			
Recommended Previous	Calculus			
Knowledge	Discrete algebraic structures (combinatorics)			
	Propositional logic			
	- Propositional rogio			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge				
	dependence, independence assumptions) used in discrete and			
	describe characteristic notions such as expected values, varia			
	explain algorithms for solving these problems (based on the c	•		•
	analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for			
OL III.	solving decision and computation problem for stochastic process			
Skills	Students can apply algorithms for solving decision problems, application contexts, i.e., students can derive estimators and judg			good enough in various
	application contexts, i.e., students can derive estimators and judg	e whether they are applicable of reliab	ie.	
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their regular home w	ork) in heterogeneously composed tea	ms (i.e., teams from diffe	erent study programs and
	background knowledge) and to present their results appropriatel	y (e.g. during exercise class).		
Autonomy	- Students are capable of checking their understanding of comple	x concepts on their own. They can spe	cify open questions pre	cisely and know where to
,	- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.			,
	- Students can put their knowledge in relation to the contents of o	her lectures.		
	- Students have developed sufficient persistence to be able to wo	rk for longer periods in a goal-oriented	manner on hard proble	ms.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Computer Science: Compu	Ilsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation (
	General Engineering Science (English program, 7 semester): Spo	·	Isory	
	Computational Science and Engineering: Core qualification: Con			
	Logistics and Mobility: Specialisation Engineering Science: Elect	ve Compulsory		



Course L0777: Stochastics	
Тур	Lecture
Hrs/wk	2
СР	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
	Bayessche Netzwerke
	Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen
	Stochastic processes
	Stationarity, ergodicity
	• Correlations
	Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues
	Detection & estimation
	Detectors
	Estimation rules and procedures
	Hypothesis and distribution tests
	Stochastic regression
Literature	Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008
	Stochastik für 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
	l .

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		to attaches a		
Knowledge	Object-oriented programming, algorithms, and da Procedural programming	ta structures		
	1 0 0	tana ayah aa aditaya lialaya aasaallaya		
	Experience in using tools related to operating sys	terns 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 sy	stems and explain their
	architectures. The participants of the course write concur	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.		
Skilla	Students are able to use the POSIX libraries for concu	urrent programming in a correct and officient w	ay Thay are able to	judgo the officional of a
Skills	scheduling algorithm for a given scheduling task in a give		ay. They are able to	judge the elliciency of a
	scrieduling algoritim for a given scrieduling task in a give	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): Specia	lisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science: Elective	Compulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specia	lisation Computer Science: Compulsory		
	General Engineering Science (English program, 7 semes		Compulsory	
	Computational Science and Engineering: Specialisation	Computer Science: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Elective	re Compulsory		

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

Course L1154: Operating 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.

Module M0598: Mechanica	Engineering: Design			
Courses				
Title		Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD (L0268)		Lecture	2	1
= : :		Practical Course	3	2
Mechanical Design Project I (L0695)				
Mechanical Design Project II (L0592)		Practical Course	3	2
Team Project Design Methodology (L026)		Problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	 Production Engineering 			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	 explain design guidelines for machinery parts e.g. consi 	dering load situation, materials and manufa	acturing requirements,	
	 describe basics of 3D CAD, 			
	 explain basics methods of engineering designing. 			
Chille	After a section the ground of a students are able to			
SKIIIS	After passing the module, students are able to:			
	 independently create sketches, technical drawings and 	locumentations e.g. using 3D CAD,		
	 design components based on design guidelines autono 	mously,		
	dimension (calculate) used components,			
		uka ayatamtigally and calutian oriented		
	use methods to design and solve engineering design tag	ks systamically and solution-onemed,		
	 apply creativity techniques in teams. 			
Personal Competence				
Social Competence	After passing the module, students are able to:			
		and the second state of the second		
	 develop and evaluate solutions in groups including maken 	ng and documenting decisions,		
	 moderate the use of scientific methods, 			
	 present and discuss solutions and technical drawings w 	thin groups,		
	 reflect the own results in the work groups of the course. 			
Autonomy	Students are able			
	 to estimate their level of knowledge using activating me 	thods within the lectures (e.g. with clickers)	,	
	 To solve engineering design tasks systematically. 			
Workload in Hours	, , ,			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180	5 15 1 15 1 1		
Assignment for the Following	General Engineering Science (German program): Specialisation		ompulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): S			
	Energy and Environmental Engineering: Core qualification: Cor	•	J - J J	
		•	mnulcon/	
	General Engineering Science (English program): Specialisation	• •	impulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	Biomedical Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engineering: Con	npulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester): S			
	Mechanical Engineering: Core qualification: Compulsory		,g. compaisory	
	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	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-Ill; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course L0695: Mechanical Design F	Project I
Тур	Practical Course
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet
Literature	 Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.



Course L0592: Mechanical Design Project II		
Тур	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	 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 M0933: Fundamen	tals of Materials Science			
0				
Courses		_		
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L10	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2
Physical and Chemical Basics of Materials		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller	Lecture		2
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge	Thigh sollow level physics, shemistry and matternates			
Momeage				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on m	etals, ceramics and polymers a	and can describe this know	vledge comprehensive
	Fundamental knowledge here means specifically the issues of a			
	mechanical properties. The students know about the key aspec			
	characterizing specific properties. They are able to trace material	s phenomena back to the underlyin	ng physical and chemical lav	ws of nature.
Skills	The students are able to trace materials phenomena back to the	underlying physical and chemica	I laws of nature. Materials p	henomena here refers
	mechanical properties such as strength, ductility, and stiffness, c	nemical properties such as corrosi	ion resistance, and to phase	transformations such
	solidification, precipitation, or melting. The students can explain		conditions and the materials	microstructure, and th
	can account for the impact of microstructure on the material's beh	avior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Enviromental Enginee	ring: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compuls	sory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Biomedical Engineerin	ng: Compulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Naval Architecture: Co	ompulsory	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Energy and Enviromer	ntal Engineering: Compulso	ry
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Specialisation I	Energy and Enviromental Engineer	ring: Compulsory	
	General Engineering Science (English program): Specialisation !	Mechanical Engineering: Compuls	ory	
	General Engineering Science (English program): Specialisation I	Biomedical Engineering: Compulso	ory	
	General Engineering Science (English program): Specialisation I	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Spe	ecialisation Mechanical Engineerin	ng: Compulsory	
	General Engineering Science (English program, 7 semester): Spe	ecialisation Biomedical Engineerin	g: Compulsory	
	General Engineering Science (English program, 7 semester): Spe	ecialisation Naval Architecture: Co	mpulsory	
	General Engineering Science (English program, 7 semester): Spe	ecialisation Energy and Enviromen	ntal Engineering: Compulsor	у
	Logistics and Mobility: Specialisation Engineering Science: Elect	ve Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			

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



Course L0506: Fundamentals of 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 Chemi	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 M	lachines			
0				
Courses				
Title		Тур	Hrs/wk	CP
Electrical Machines (L0293) Electrical Machines (L0294)		Lecture	3 2	4
	A.I	Recitation Section (large)	2	2
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous Knowledge	Basics of mathematics, in particular complexe numbers, integrals, diff	erenuais		
Kilowieuge	Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principles of electric and	magnetic fields.		
	They can describe the function of the standard types of electric m	achines and present the correspor	nding equations and cl	haracteristic curves. For
	typically used drives they can explain the major parameters of the en	·		
01.71	Or death and the selection of the select	· Caldada a cada da Cara cara cara da cada		all to the constant of the constant
Skills	Students arw able to calculate two-dimensional electric and magneti	c fields in particular ferromagnetic ci	rcuits 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 for	om their given characteristic data ar	nd selected quantities a	and characteristic curves
	They apply the usual equivalent circuits and graphical methods.			
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate electric and magnati	c fields for applications. They are	able to analyse indepe	endently the operational
	performance of electric machines from the charactersitic data and the	ycan calculate thereof selected quar	ntities and characteristic	c 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 Ene	rgy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation Med	hanical Engineering: Elective Comp	ulsory	
	General Engineering Science (German program, 7 semester): Specia	lisation Energy and Enviromental E	ngineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineering: El	ective Compulsory	
	Electrical Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Compuls	ory		
	General Engineering Science (English program): Specialisation Energy	gy and Enviromental Engineering: C	Compulsory	
	General Engineering Science (English program): Specialisation Med	nanical Engineering: Elective Comp	ulsory	
	General Engineering Science (English program, 7 semester): Specia	isation Energy and Enviromental Er	ngineering: Compulsory	1
	General Engineering Science (English program, 7 semester): Specia	isation Mechanical Engineering: Ele	ective Compulsory	
	Computational Science and Engineering: Specialisation Engineering			
	Logistics and Mobility: Specialisation Engineering Science: Elective (Compulsory		
	Mechanical Engineering: Core qualification: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory			



Course L0293: Electrical Machines	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	NN
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	NN
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	Management		
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 ha	ave 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	e in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following	General Engineering Science (German p	program): Specialisation Mechanical Engineering: Elective Co	mpulsory	
Curricula	General Engineering Science (German p	program, 7 semester): Specialisation Mechanical Engineering	: Elective Compulsory	
	General Engineering Science (English p	rogram): Specialisation Mechanical Engineering: Elective Co	mpulsory	
	General Engineering Science (English p	rogram, 7 semester): Specialisation Mechanical Engineering:	Elective Compulsory	
	Logistics and Mobility: Specialisation Eng	gineering Science: Elective Compulsory		
	Mechanical Engineering: Core qualificati	ion: Elective Compulsory		

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



Course L0926: Quality Management	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
Content	Definition and Relevance of Quality Continuous Quality Improvement Quality Management in Product Development Quality Management in Production Processes Design of Experiments
Literature	 Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002 Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001 Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008 Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009



'ourono				
Courses				
ïtle		Тур	Hrs/wk	СР
ignals and Systems (L0432)		ecture	3	4
ignals 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 systems. Good kn	owledge in maths as covere	ed by the moduls Math	nematik 1-3 is exne
	Further experience with spectral transformations (Fourier series, Fourier trans			icinatik i o io expe
	Turiner experience with spectral transformations (Fourier series, Fourier trans	om, Lapiace transform, is us	seiai bat not required.	
Educational Objectives	After taking part successfully, students have reached the following learning re-	sults		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invaria	ent (LTI) systems using metho	ods of signal and syste	em theory. They are
	to apply the fundamental transformations of continuous-time and discrete-time			
	and systems mathematically in both time and image domain. In particular,			
	caused by the transition of a continuous-time signal to a discrete-time signal.	and and ordered and one of the	uno doman and n	nago domam wino.
Skille	The students are able to describe and analyse deterministic signals and line.	ar time-invariant eveteme usi	na methods of signal	and evetem theory
Skills	can analyse and design basic systems regarding important properties such a	•	-	
			ponse, stability, ililean	ity etc They can as
	the impact of LTI systems on the signal properties in time and frequency doma	JII.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from appropriate litera	ture sources. They can cont	trol their level of know	ledge during the le
	period by solving tutorial problems, software tools, clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical En	aineerina: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Computer (German program): Specialisation			
	General Engineering Science (German program): Specialisation Process Eng			
	General Engineering Science (German program): Specialisation Bioprocess B			
	General Engineering Science (German program): Specialisation Civil- and En	viromental Engeneering: Co	mpulsory	
	General Engineering Science (German program): Specialisation Mechanical	Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Biomedical E	Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation	Electrical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation I			
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation	Mechanical Engineering, Foo	cus Energy Systems: C	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation	Mechanical Engineering, Foo	cus Aircraft Systems Er	ngineering: Compul
	General Engineering Science (German program, 7 semester): Specialisat	ion Mechanical Engineering	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation I	Mechanical Engineering, For	cus Mechatronics: Con	npulsory
	General Engineering Science (German program, 7 semester): Specialisation	on Mechanical Engineering	. Focus Theoretical M	Mechanical Enginee
	Compulsory	59		
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
		viromontal Engantarias O	mnulcon.	
	General Engineering Science (English program): Specialisation Civil- and En	0 0	inpuisory	
	General Engineering Science (English program): Specialisation Bioprocess E	0 0 1 ,		
	General Engineering Science (English program): Specialisation Electrical Engineering			
	General Engineering Science (English program): Specialisation Computer Science	ience: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical E	Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Biomedical E	ingineering: Compulsory		
	General Engineering Science (English program): Specialisation Process Engi	neering: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation E	Electrical Engineering: Comp	ulsory	
	General Engineering Science (English program, 7 semester): Specialisation C		•	
	General Engineering Science (English program, 7 semester): Specialisation F		-	
	General Engineering Science (English program, 7 semester): Specialisation E			
	General Engineering Science (English program, 7 semester): Specialisation E			nnulaar:
	General Engineering Science (English program, 7 semester): Specialisation N			
	General Engineering Science (English program, 7 semester): Specialisation M			
	General Engineering Science (English program, 7 semester): Specialisation M	Mechanical Engineering, Foo	us Aircraft Systems En	gineering: Compuls
	General Engineering Science (English program, 7 semester): Specialisation	ion Mechanical Engineerinç	g, Focus Materials in	Engineering Scien
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation M	Mechanical Engineering, Foc	us Mechatronics: Com	pulsory
	General Engineering Science (English program, 7 semester): Specialisation	-		
	Compulsory	.5		
	Computational Science and Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals and Systems	S
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN 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	chanics 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 th	e general principles of fluid engineering an	d physics of fluids.	Students can scientificall
	outline the rationale of flow physics using mathematical model	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	-physics models for the analysis of technics	al evetame. The lecti	ire anables the student to
OKIIIS	carry out all necessary theoretical calculations for the fluid dyna			ire enables the student to
	carry car an incooccary anonouscal canonication on the maid aying	a coolgii or originoomig actioco on a colo		
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop s	olution strategies.		
Autonomy	The students are able to develop solution strategies for complex	problems self-consistent and crtically analy	se results.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	n Biomedical Engineering: Compulsory		
	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		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		у	
	Mechanical Engineering: Core qualification: Compulsory	Compulsory		
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		
	and the state of t			

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



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	Mataviala			
Module MU934: Advanced I	wateriais			
Courses				
Title		Тур	Hrs/wk	CP
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	llowing learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of adv	vanced materials along with their applications	in technology, in par	ticular metallic, ceramic,
	polymeric, semiconductor, modern composite materials (bid	omaterials) and nanomaterials.		
Chille	The students will be able to called material configurations	a according to the technical according and if an		
Skills	The students will be able to select material configuration	•	•	-
	architectural principles from the micro- to the macroscale. select optimum materials combinations depending on the tr	*	dem materials science	e, which enables them to
	select optimum materials combinations depending on the tr	ecimical applications.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists and	d to develop ideas further.		
Autonomy	The students are able to			
	the Comment of the Co			
	assess their own strengths and weaknesses.			
	 define tasks independently. 			
Workland in House	Indiana de at Chiele Time OC Chiele Time in Leature OA			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points Examination	Written exam			
Examination duration and scale				
	90 min	action Machanical Engineering: Floative Comp	ulaani	
Assignment for the Following Curricula	General Engineering Science (German program): Specialis General Engineering Science (German program, 7 semestr		•	
Cui ricula	General Engineering Science (German program, 7 semestr General Engineering Science (English program): Specialis	, ,		
	General Engineering Science (English program). Specialis		•	
	Mechanical Engineering: Core qualification: Elective Comp		cave Compulsory	
	Medianical Engineening. Our quanication. Elective Comp	701301 y		

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	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	ving learning results		
Professional Competence				
Knowledge	The students can			
	 describe the axiomatic procedure used in mechanical 	contexts;		
	 explain important steps in model design; 			
	present technical knowledge.			
Skills	The students can			
	explain the important elements of mathematical / mechanical / mec	anical analysis and model formation, and ap	ply it to the context of	their own problems;
	apply basic methods to engineering problems;			
	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 ov	ercome difficulties.		
Autonomy	Students are capable of determining their own strengths and	weaknesses and to organize their time and le	arning based on thos	se.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisat	on 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): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: 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): 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: 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	y	

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 - Vibration of Multi-degree of freedom systems - 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). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).	



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



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



Тур	Laboratory Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Wolfgang Schröder
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutar
	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 Mich
	interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	Letter We Direction and the Life and through the second of the Alexander and the Alexander Co. A. f. Westernich
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschal
	 Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Mün
	Wien, 1979
	 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung
	Gebrauchs- und Bedienungsanweisungen
	 VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1
	Versuch 2:
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren
	Simulationsmethoden, speziell: Verwendung von Blockschaltbildern
	Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze
	Versuch 3:
	Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984
	 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988
	Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989
	Versuch 4:
	Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden
	Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen
	- van Eures. Systemineorensone Grundragen, Anaryse und Entwart emschileniger fregerungen



Course L1116: Measurement Technology for Mechanical and Process Engineers	
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
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 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	
Recommended Previous	
Knowledge	Busin Niewieuge of Mutateritatios 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
	 explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
	 explain the most important aspects of and goals in Management and name the most important aspects of emploitant aspects. 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 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 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
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting costing and controlling to predefined problems.
	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
Autonomy	olderio 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	
Examination	Written exam
Examination duration and scale	90 minutes
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 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 Electrical Engineering: Compulsory 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 semiester): 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 Engineeri



Compulsory

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

impulsory

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

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolf
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Manage 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, Ann-Isabell Hnida, Hamed Farhadian, Katharina Roedelius, Oliver Welling, Maximilian Muelke
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



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	oduction to Anatomy
0	
Courses	T Hustels OD
Title Introduction to Anatomy (L0384)	Typ Hrs/wk CP Lecture 2 3
Module Responsible	Prof. Udo Schumacher
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeletal system.
· · · · · · · · · · · · · · · · · · ·	The students can describe the basic macroscopy and microscopy of those systems.
Skills	
	relevance of structures and their functions in the context of widespread diseases.
Personal Competence	
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquire the relevant knowledge themselves.
	meniserves.
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	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 th week: Nervous System 13 th week: Exam
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012



Module M1278: MED I: Intro	oduction to Radiology and Radiation Therapy
Courses	
Fitle Fitle	Typ Hrs/wk CP
ntroduction to Radiology and Radiation Ti	herapy (L0383) Lecture 2 3
Module Responsible	
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Therapy
	The students can distinguish different types of currently used equipment with respect to its use in radiation therapy.
	The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e.g. surgery, internal medicine).
	The students can describe the patients' passage from their initial admittance through to follow-up care.
	Diagnostics
	The students can illustrate the technical base concepts of projection radiography, including angiography and mammography, as well as 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 depending on the patient's clinical history and needs.
	The student can explain the influence of technical errors on the imaging techniques.
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.
Skills	Therapy The students can distinguish curative and palliative situations and motivate why they came to that conclusion.
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.
	The students can use the therapeutic principle (effects vs adverse effects)
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help group social services, psycho-oncology).
	Diagnostics
	The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology are pathophysiology.
Personal Competence	
Social Competence	The students can assess the special social situation of tumor patients and interact with them in a professional way. The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet the appropriately.
Autonomy	The students can apply their new knowledge and skills to a concrete therapy case.
Adionomy	The students can introduce younger students to the clinical daily routine.
	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the
	relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points Examination	3 Written exam
Examination Examination	90 minutes
Assignment for the Following	
Curricula	
	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, English programs (Compulsory)
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Technomathematics: 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	
Lecturer Language	, ,
Cycle	
Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments
Literature	"Technik der medizinischen Radiologie" von T. + J. Laubenberg –
	7. Auflage – Deutscher Ärzteverlag – erschienen 1999
	"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
	4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
	ISBN: 978-3-437-23960-1
	"Strahlentherapie und Onkologie für MTA-R" von R. Sauer –
	5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschienen 08.12.2009
	ISBN: 978-3-437-47501-6
	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	"Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000



urses				
e		Тур	Hrs/wk	CP
merical Mathematics I (L0417) merical Mathematics I (L0418)		Lecture Recitation Section (small)	2	3 3
	Prof. Sabine Le Borne	Heditation decitor (Smail)	2	3
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	 Mathematik I + II for Engineering Students (get 	rman or english) or Analysis & Linear Algebra I + II fo	r Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached	he following learning results		
Professional Competence				
Knowledge	Students are able to			
	· ·	tegration, least squares problems, eigenvalue prob	olems, nonlinear root	finding problems an
	explain their core ideas,			
	repeat convergence statements for the numeri			
	explain aspects for the practical execution of n	umerical methods with respect to computational and	storage complexitx.	
01.77	Objects are able to			
SKIIIS	Students are able to			
	implement, apply and compare numerical met	hods using MATLAB,		
	justify the convergence behaviour of numerica	I methods with respect to the problem and solution a	lgorithm,	
	select and execute a suitable solution approach	ch for a given problem.		
Barranal Cammatana				
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously composed	teams (i.e., teams from different study programs an	d background knowle	edge), explain theore
	foundations and support each other with pract	ical aspects regarding the implementation of algorith	ms.	
	0. 1			
Autonomy	Students are capable			
	to assess whether the supporting theoretical a	nd practical excercises are better solved individually	or in a team,	
	to assess their individual progess and, if necess	ssary, to ask questions and seek help.		
Wester de Heer	Indiana day Onda Taya 404 Onda Taya in Last as 5			
Workload in Hours		16		
Credit points				
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following				
Curricula				
	General Engineering Science (German program): Spe		s in Engineering Scie	nces: Compulsory
	General Engineering Science (German program): Spe			
	General Engineering Science (German program, 7 se	, ,	•	- F11 0-1
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engineerin	g, Focus Materiais I	n Engineering Scien
	Compulsory General Engineering Science (German program, 7 se	moster): Specialization Biomedical Engineering: Co	moulcon	
	General Engineering Science (German program, 7 se	, ,		ampulcon,
	Bioprocess Engineering: Specialisation A - General B		cus biomechanics. Ot	Jiipuisory
	Computer Science: Specialisation Computational Mai	1 0 0 1 7		
	Electrical Engineering: Core qualification: Elective Co			
	General Engineering Science (English program): Spe			
	General Engineering Science (English program): Spe	' ' '		
	General Engineering Science (English program): Spe		anics: Compulsorv	
	General Engineering Science (English program): Spe	• •		nces: Compulsorv
	General Engineering Science (English program, 7 sec	* *		, , ,
	General Engineering Science (English program, 7		•	n Engineering Scien
	Compulsory	, ,		3 3
	General Engineering Science (English program, 7 ser	mester): Specialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 set	, ,		mpulsory
	Computational Science and Engineering: Core qualifi	cation: Compulsory		
	Process Engineering: Specialisation Process Engineering	rian Flantina Camandaan		



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

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



Module M0684: Heat Trans	ier			
modulo modo irricat riano				
Courses				
Title		Тур	Hrs/wk	CP
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g 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	approach.		
Autonomy	The students are able to develop a complex problem self-consist	ent 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			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min	Marketin Francisco Francisco Biometro		
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		stems: Compulsory	
	General Engineering Science (German program): Specialisation		al Machanical Engine	oring: Compulacry
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (German program, 7 semester):			
	Compulsory	Specialisation Mechanical Engineering,	Tocus medical iv	lechanical Engineening.
		ocialisation Riomodical Engineering: Com	nulcon	
	General Engineering Science (German program, 7 semester): Sp General Engineering Science (English program): Specialisation I		paidory	
	General Engineering Science (English program): Specialisation I General Engineering Science (English program): Specialisation I		nice: Compulsory	
	General Engineering Science (English program): Specialisation I	* *		
	General Engineering Science (English program): Specialisation I	0 0, ,	, ,	ering: Compulsory
	General Engineering Science (English program, 7 semester): Sp.		-	
	General Engineering Science (English program, 7 semester): Sp. General Engineering Science (English program, 7 semester):			
	Compulsory	CPCCIA ISARON MECHANICAL ENGINEERING,	1 0003 THEOTERICAL IV	conamoa Engineeniig.
	General Engineering Science (English program, 7 semester): Sp.	ecialisation Biomedical Engineering: Com	oulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compu		,	
	Mechanical Engineering: Specialisation Theoretical Mechanical			
	5 6 ,	<u> </u>		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



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

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



Module M1333: BIO I: Impla	ints and Fracture Healing
Courses	
Title	Typ Hrs/wk CP
Implants and Fracture Healing (L0376)	Lecture 2 3
Module Responsible	Prof. Michael Morlock
Admission Requirements	None
Recommended Previous	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence.
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.
Skille	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.
OKIIIS	The students can determine the forces acting within the number body under quasi-static students under specific assumptions.
Personal Competence	
Social Competence	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.
Autonomy	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.
Autonomy	The statents can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



Course L0376: Implants and Fractur	re Healing
-	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.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat



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

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	



Module M1332: BIO I: Expe	rimental Methods in Biomechanics			
Courses				
ïtle		Тур	Hrs/wk	CP
experimental Methods in Biomechanics (L	0377)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate und Fra	akturheilung" before attending "Experimentelle M	Methoden".	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	The students can describe the different ways how bon	es heal, and the requirements for their existence	э.	
	The students can name different treatments for the spin	ne and hollow bones under given fracture morph	hologies.	
	The students can describe different measurement tech	niques for forces and movements, and choose	the adequate technique for	a given task.
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.			
Personal Competence				
Social Competence	The students can, in groups, solve basic experimental	tasks.		
Autonomy	The students can, in groups, solve basic experimental	tasks.		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Mechanical Engineering, Focus Bior	mechanics: Compulsory	
Curricula	General Engineering Science (German program): Spe	* *		
	General Engineering Science (German program, 7 ser		•	mpulsory
	General Engineering Science (German program, 7 ser	, ,		-
	General Engineering Science (English program): Spec	cialisation Biomedical Engineering: Compulsory	,	
	General Engineering Science (English program): Spec	cialisation Mechanical Engineering, Focus Biom	nechanics: Compulsory	
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engineering	, Focus Biomechanics: Cor	npulsory
	General Engineering Science (English program, 7 ser	nester): Specialisation Biomedical Engineering:	Compulsory	
	Mechanical Engineering: Specialisation Biomechanical	s: Compulsory		
	Biomedical Engineering: Specialisation Artificial Organ	ns and Regenerative Medicine: Elective Compu	lsory	
	Biomedical Engineering: Specialisation Implants and	Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology	nology and Control Theory: Elective Compulsor	у	
	Biomedical Engineering: Specialisation Management	and Business Administration: Elective Compuls	ory	
	Technomathematics: Specialisation III. Engineering Sci	cience: Elective Compulsory		

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



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 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:			
oe	The passing the medic, stadents are asie to:			
	 accomplish dimensioning calculations of cover 	ed machine elements,		
	 transfer knowledge learned in the module to ne 	ew requirements and tasks (problem solving skills),		
	 recognize the content of technical drawings an 	d schematic sketches,		
	 evaluate complex designs, technically. 			
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		
		rledge and to recapitulate poorly understood conte	ent o a by using the	video recordings of
	lectures.	neage and to recapitulate poorly understood conte	ant e.g. by using the	video recordings of
	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
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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
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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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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 ser Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser	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, mester): Specialisation Mechanical Engineering, semester): Specialisation Mechanical Engineering, semester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focus mester): Specialisation Mechanical Engineering, Focialisation Mechanical Engin	ystems Engineering: (in Engineering Scientics: Compulsory Development and Protest Mechanical Engineus Aircraft Systems Etg., Focus Materials in us Mechatronics: CorFocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corstems: Compulsory	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls n Engineering Scien npulsory opment and Produc Mechanical Enginee mpulsory 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 ser Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser General Engineering Science (German program): Spec	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, semester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, Focus cialisation Mechanical Engineering, Focus Energy Specialisation Mechanical Engineering, Focus Aircraft Sy	ystems Engineering: (in Engineering Scientics: Compulsory Development and Protest Mechanical Engineus Aircraft Systems Etg., Focus Materials in us Mechatronics: CorFocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corstems: Compulsory stems Engineering: Corstems: Compulsory	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls n Engineering Scien npulsory opment and Produc Mechanical Enginee mpulsory Compulsory 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 Compulsory General Engineering Science (German program, 7 set Compulsory General Engineering Science (German program, 7 set General Engineering Science (German program, 7 set General Engineering Science (German program, 7 set General Engineering Science (German program): Spec General Engineering Science (English program): Spec General Engineering Science (English program): Spec	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Mechatro cialisation Mechanical Engineering, Focus Product I cialisation Mechanical Engineering, Focus Theoretic mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, semester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, mester): Specialisation Mechanical Engineering, Focus Energy Specialisation Mechanical Engineering, Focus Aircraft Sp cialisation Mechanical Engineering, Focus Materials	ystems Engineering: (in Engineering Sciennics: Compulsory Development and Proval Mechanical Engineus Aircraft Systems Engineus Mechatronics: CorFocus Product Develors Theoretical Mechanics: Cous Energy Systems: Corstems: Compulsory (stems Engineering: Coin Engineering: Coin Engineering Science	duction: Compulsory duction: Compulsory pering: Compulsory ngineering: Compuls n Engineering Scien npulsory opment and Produc Mechanical Enginee mpulsory Compulsory 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 General Engineering Science (German program): Spe General Engineering Science (English program): Spe	cialisation Mechanical Engineering, Focus Aircraft S cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro 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 Energy Specialisation Mechanical Engineering, Focus Energy Specialisation Mechanical Engineering, Focus Energy Specialisation Mechanical Engineering, Focus Aircraft Specialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Materials cialisation Mechanical Engineering, Focus Mechatro	ystems Engineering: (in Engineering Scientics: Compulsory Development and Protal Mechanical Engineus Aircraft Systems Etg., Focus Materials in us Mechatronics: CorFocus Product Develous Theoretical Mechanics: Cous Energy Systems: Corpulsory (stems Engineering Scientics: Compulsory Inc.)	duction: Compulsory duction: Compulsory duction: Compulsory duction: Compulsory dering: Compulsory ngineering: Compuls dering: Compuls dering: Compulsory dering: Compulsory Compulsory Compulsory des: Compulsory
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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, Compulsory
	Naval Architecture: Core qualification: Compulsory
Course L0264: Advanced Mechanic	al Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Facility 1
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
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.
I	I

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	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe WiSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Design 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.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Finführung in die DIN-Normen: Klein M. Teubner-Verlag
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - 2, Schlecht, B., Pearson Verlag, axuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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



Module M0655: Computation	onal Fluid Dynamics I			
·	<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	Mathematical Methods for Engineers Fundamentals of Differential/integral calculus and series expansions			
	- Tandamentals of Dinorental/megral saledads 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,	0, ,	, ,
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Ele	ctive Compulsory		

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



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



Courses				
ïtle		Тур	Hrs/wk	CP
as and Steam Power Plants (L0206)		Lecture	3	4
Sas and Steam Power Plants (L0210)	Doct Alfano Kallan	Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous	The decided The considerate of the decided			
Knowledge	"Technical Thermodynamics I and II" "Heat Transfer"			
	"Fluid Mechanics"			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can evaluate the development of the e			
	types of power plant and the layout of the steam of			
	Additionally they can describe the exhaust gas clear solar thermal and geothermal power plants or plants		or conventional tossii-i	ruelled power plants
	The students have basic knowledge about the princi	ples, operation and design of turbomachinery		
Skille	The students will be able, using theories and metho	ds of the energy technology from fossil fuels and bas	sed on well-founded k	nowledge on the fund
OKIIIS	and construction of gas and steam power plants, to			
		osure to the inherent interplay between heat and po		
	the capability and methodology to develop realistic of	· ·	-	
	the students become the ability to follow better the c	deliberations on the electricity mix composition within	the energy-political t	riangle (economy, se
	supply and environmental protection).			
	Within the framework of the exercise the students le	arn the use of the specialised software suite ERSII (N Professional TM Wis	th this tool small prac
	tasks are solved with the PC, to highlight aspects of t		on Fiolessional . Wi	in this tool small prac
	The students are able to do simplified calculations or		omponent or at stage l	evel
Personal Competence	As a constant that the form of the last of the	leaved for the death that are later and The state days	and the first and a second second	
Social Competence	An excursion within the framework of the lecture is p		•	
	power plant in this region. The students will obtain technical and political issues.	ilist-nand expenence with a power plant in operation	on and gain msignis i	into the conflicts betw
Autonomy	The students assisted by the tutors will be able to	develop alone simple simulation models and run wi	th these scenario ana	llyses. In this manne
natoriomy	theoretical and practical knowledge from the lectu	·		•
	conditions highlighted. The students are able inde			
	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): Sp			
Curricula	General Engineering Science (German program): Sp			
	General Engineering Science (German program, 7 s	, , , , ,		•
	General Engineering Science (German program, 7 s Energy and Environmental Engineering: Core qualifi	emester): Specialisation Mechanical Engineering, Fo	cus Eriergy Systems:	Elective Compulsory
	General Engineering Science (English program): Sp	·	Compulsory	
		ecialisation Mechanical Engineering, Focus Energy		
	General Engineering Science (English program, 7 se			у
	General Engineering Science (English program, 7 se			
		_ 0,		



Course L0206: Gas and Steam Pow	er Plants	
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Alfons Kather	
Language	DE	
Cycle	WiSe	
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:	
	Electricity demand and Forecasting	
	Thermodynamic fundamentals	
	Energy Conversion in thermal power plants	
	Types of power plant	
	Layout of the power plant block	
	Individual elements of the power plant	
	Cooling systems	
	Flue gas cleaning	
	Operation characteristics of the power plant	
	Construction materials for power plants	
	Location of power plants Only the model which of the model that the Contract of Contract the model that the contract that the contract the model that the contract that	
	Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.	
	These are complemented in the 2 nd part of the module by the more specialised issues:	
	Energy balance of a turbomachine	
	Theory of turbine and compressor stage	
	Equal and positive pressure blading	
	Flow losses	
	Characteristic numbers	
	Axial and radial design	
	Design features	
	Hydraulic turbomachines	
	Pump and water turbine designs	
	Design examples of reciprocating engines and turbomachinery	
	Steam power plants	
	Gas turbine systems.	
Literature	Kalide: Kraft- und Arbeitsmaschinen	
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985	
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006	
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990	
	Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technische	
	Verlag Resch / Verlag TÜV Rheinland	



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 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	 Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus 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
	 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technische



Module M0684: Heat Transf	fer			
Courses				
Title		Typ	Hrs/wk	CP
Heat Transfer (L0458)		Typ Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski	ricollation occiton (large)	-	
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following 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 as a student and the stu	pproach.		
Autonomy	The students are able to develop a complex problem self-consister	nt and analyse the results in a critical wa	av A qualified exchan	ne with other students is
ria one my	given.	it and analysis are resulted in a shabar we	.y. / i quamou oxonan	go mar ouror oladorilo io
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	echanical Engineering, Focus Biomecha	anics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation M	echanical Engineering, Focus Energy S	ystems: Compulsory	
	General Engineering Science (German program): Specialisation Bi	omedical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering,	Focus Theoretical M	lechanical Engineering:
	Compulsory			
	General Engineering Science (German program, 7 semester): Spec		npulsory	
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program): Specialisation Me		-	
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): S Compulsory	pecialisation Mechanical Engineering,	Focus Theoretical M	lechanical Engineering:
	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			

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z. Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



Module M1022: Reciprocation	ng Machinery			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0633)		Lecture	1	1
	d 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 followin	g learning results		
Professional Competence				
Skills Personal Competence Social Competence	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 widespread scope of gained knowledge enables the student Independent Study Time 110, Study Time in Lecture 70		solon madpendently a	na comacmay.
	6			
·	vitten exam			
	120 min			
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Energy 9	Systems: Compulsory	
-	General Engineering Science (German program, 7 semester): Sp			Compulsory
	General Engineering Science (German program): Specialisation			paidoi y
	activities and a control of the cont		, otomo. Oompaidory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering, Foc	us Energy Systems: C	ompulsory



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	Findings
	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	See interlocking course
Literature	See interlocking course



Focus Aircraft Systems Engineering

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

Master Energy Engineering or an ec	onomical oriented master study.			
Module M0597: Advanced	Mechanical Engineering Design			
0				
Courses			Heated	0.0
Title Advanced Mechanical Engineering Desigr	JI (10364)	Typ Lecture	Hrs/wk	CP 2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
				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			
	 indicate the background of dimensioning calculations. 		•	
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered made	hine elements,		
	 transfer knowledge learned in the module to new requ 	irements and tasks (problem solving skills),		
	 recognize the content of technical drawings and scher 	natic sketches,		
	 evaluate complex designs, technically. 			
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
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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 impulsory 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
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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 Energy Syon Mechanical Engineering, Focus Engineering, Focus Engineering, Focus Engineering, Focus Enginee	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
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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.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Machingaglament 1.0. Schlagt B. Baggag Voldag 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.	
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 	
	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) Practica	al Course	4	6
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Mechanical Engineering: Design			
Knowledge	Advanced Mechanical Engineering Design			
	ů ů ů			
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 consistent the smooth to act and a state and a			
SKIIIS	After passing the module, students are able to:			
	analyze complex tasks and develop principle solutions using sketches,			
	 convert principle solutions into a detailed design, 			
	 use methods to design and solve engineering design tasks systematically a 	and solution-oriented,		
	create a technical documentation including all necessary technical drawings	s 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:			
	The paramy to the second and the			
	 present and discuss solutions and technical drawings within groups, 			
	reflect the own results in the work groups of the course			
Autonomy	After passing the module, students are able to:			
,				
	 independently solve complex design projects, while motivating themselves, 	, acquiring necessary knowled	dge and selecting a	appropriate method
	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 Engin	neering, Focus Aircraft System	ns Engineering: Co	mpulsory
Curricula	General Engineering Science (German program): Specialisation Mechanical Engin	neering, Focus Product Devel	opment and Produc	ction: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engin	neering, Focus Theoretical Me	chanical Engineer	ing: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mecha	anical Engineering, Focus Ai	rcraft Systems Engi	neering: Compulso
	General Engineering Science (German program, 7 semester): Specialisation Me	chanical Engineering, Focus	Product Develop	ment and Producti
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Me	echanical Engineering, Focu	us Theoretical Med	chanical Engineeri
	Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engine	eering, Focus Aircraft System	s Engineering: Cor	npulsory
	General Engineering Science (English program): Specialisation Mechanical Engine	eering, Focus Product Develo	pment and Produc	tion: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engine	-	-	
	General Engineering Science (English program, 7 semester): Specialisation Mecha	0 0,	, ,	0 1
	General Engineering Science (English program, 7 semester): Specialisation Me	chanical Engineering, Focus	Product Develop	ment and Product
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Me	echanical Engineering, Focu	us Theoretical Med	chanical Engineer
	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	
	 Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten 	
	 Erstellung einer ausführlichen Dokumentation 	
	Lösungsfindung	
	 Methodische Erarbeitung von prinzipiellen Lösungskonzepten 	
	Erstellen einer Dokumentation	
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.	
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.	
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.	
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.	
	Sowie weitere Bücher zu speziellen Themen	



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 III Lecture 56			
	 		
	• •		
		-	
eneral Engineering Science (German program, 7 semes	ster): Specialisation Mechanical Engineering	, Focus Theoretical I	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
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		
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 [®] and Simulink [®]
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	Hrs/wk 2 2	CP 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 of			
Knowledge	After completing the module, students are capable of:			
	explaining the functional principle of 3D-CAD-Systems	•		
	 describing the interaction of the different CAE-Systems 	in the product development process		
Skills				
	After completing the module, students are able to:			
	 evaluate different CAD- and PDM-Systems with regards design an exemplary product using CAD-,PDM- and/or 		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:			
	 independently adapt to a CAE-Tool and complete a giv 	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	 Practical Introduction in the used software systems (Creo, Windchill, Hyperworks) Team formation, allocation of tasks and generation of a project plan Collective creation of one product out of CAD models supported by FEM calculations and PDM system Manufacturing of selected parts using 3D printer Presentation of results Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.
Literature	-

Course L0270: Development of 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	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.

Course L0269: Integrated Product Development I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	SoSe	
Content	Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X	
Literature	 Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag 	



Module M0767: 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 thermodynamic	s		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge				
	knowledge of the relationchips, the key parameters, role	es 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 and their technical system			
	implementation. In addition, they can apply the learner			•
	context of the overall system.	-	•	,
Personal Competence				
Social Competence	Students are made aware of interdisciplinary communic	cation in groups.		
Autonomy	Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory			
Curricula	General Engineering Science (German program, 7 sem			
3	General Engineering Science (English program): Speci	, ,	,	0 0 1 ,
	General Engineering Science (English program, 7 sem			
	Logistics and Mobility: Specialisation Logistics and Mol		,	3 1
	Mechanical Engineering: Specialisation Aircraft System			

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	
Literature		
	- 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	 V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4 P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0 	

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



Focus Materials in Engineering Sciences

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

technological problems.				
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering Design	n II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design		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	 Fundamentals of Mechanical Engineering Design 			
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 healt required of dispensioning colours.	practical examples of complex mad	mine elements,	
	 indicate the background of dimensioning calculations. 			
Skills	After passing the module, students are able to:			
	 accomplish dimensioning calculations of covered machine eleme 	nts,		
	 transfer knowledge learned in the module to new requirements ar 	nd tasks (problem solving skills),		
	 recognize the content of technical drawings and schematic sketch 	ies,		
	 evaluate complex designs, technically. 			
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 Tooks to the Control Manaking to the Control Man
	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, and A. fleuer. Machine ausgesche Besch W. Nieuwen, G. Gerinen M. Machine, and A. fleuer. Die Stein der Gerine ausgesche Besch W. M. Gerine ausgesche Besch auf der Gerine aus
	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 Control of the Park No. 1) Andrews (An
	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
	 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 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 able to name the influencing 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 Mechanical Properties of Materials	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Norbert Huber, 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.



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

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



Module 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			able to effectively presen
	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)
	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		Tun	Hrs/wk	CP
	leh (maya (11999)	Typ Lecture	nrs/wk 2	2
Enhanced Fundamentals: Ceramics and F Enhanced Fundamentals: Ceramics and F		Recitation Section (large)	1	1
Enhanced Fundamentals: Metals (L1086)	Olymers (E1204)	Lecture	2	3
	Prof. Gerold Schneider			
Admission Requirements	None			
Recommended Previous	Module "Fundamentals of Materials Science"			
Knowledge				
	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
	Widdle Advanced Waterials			
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 follow	owing topics		
	in metals, polymers and ceramics: Atomic bonds, crystal and an	norphous structures, defects, electrical	and mass transport, n	nicrostructure and pha
	diagrams. They are capable to explain the corresponding technic	al terms.		
Skills	The students are able to apply the appropriate physical and chem	ical methods for the above mentioned s	subjects.	
			,	
Personal Competence				
Social Competence				
Autonomy	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to crital			
	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): Specialisation	Mechanical Engineering, Focus Materia	ls in Engineering Scier	ces: Compulsory
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering	ng, Focus Materials in	Engineering Science
	Compulsory			
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering	, Focus Product Devel	opment and Production
	Compulsory			
	General Engineering Science (English program): Specialisation M	Mechanical Engineering, Focus Material	s in Engineering Scien	ces: Compulsory
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering	ng, Focus Materials in	Engineering Science
	Compulsory			
	General Engineering Science (English program, 7 semester): S	Specialisation Mechanical Engineering	, Focus Product Devel	opment and Production
	Compulsory			
	Mechanical Engineering: Specialisation Materials in Engineering	Sciences: Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Elec	tive Compulsory		



Course L1233: Enhanced Fundamen	ntale: Caramice and Polymere
	Lecture
Typ Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	1. Einführung
	Natürliche "Keramiken" - Steine
	"Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al2O3-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik
	Sprühtrockner
	O Farmanhura
	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
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe
	G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €



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

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



Focus Mechatronics

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

	nted master study.			
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Mechanical Engineering Design	n II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design II (L0265) Recitation Section (large			2	1
Advanced Mechanical Engineering Design I (L0262) Lecture 2			2	
Advanced Mechanical Engineering Design	sign I (L0263) Recitation Section (large) 2 1			
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,	
	 explain requirements, selection criteria, application so 			
	indicate the background of dimensioning calculations			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered made.	chine elements,		
	 transfer knowledge learned in the module to new requ 	irements and tasks (problem solving skills),		
	 recognize the content of technical drawings and sche 	matic sketches,		
	 evaluate complex designs, technically. 			
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.			
	Independent Chidu Time CO. Chidu Time in Leabure 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, Focus	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 Engineer	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 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: Co in Engineering Scien	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 Product Dinametrical Engine	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 duction: Compulsory ngineering: Compulsor ngineering: Compulsor ngulsory opment and Production Mechanical Engineerin mpulsory 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): 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 ngineering: Compulsor npulsory opment and Production Mechanical Engineerin 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 (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 Specialisation Mechani	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 Specialisation Mechani	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 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 stems: Compulsory stems Engineering: C in Engineering Scien nics: Compulsory evelopment and Proc al Mechanical Engine us Aircraft Systems Er , 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 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 Product	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 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 Product	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 Flowerth 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	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. 	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.	
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Machine and A. O. Schladd B. B. Barnes Machine ald A. Machine and A. M	
	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		
	 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 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	ngineering III: Circuit Theory and Transients			
Courses				
Title Circuit Theory (L0566) Circuit Theory (L0567)	_	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Arne Jacob	recondition occition (small)		2
Admission Requirements	none			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge	Lieutea Engineering Fano II, wathernaucs Fano II			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge				
Skills	The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They a able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within the group.		up.	
Autonomy	The students are able to find out the required methods for solving the given practice problems. Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gains knowledge to other courses like Electrical Engineering I and Mathematics I.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following				
Curricula	General Engineering Science (German program): Specialisation		nics: Compulsory	
	General Engineering Science (German program, 7 semester): S			npulsory
	General Engineering Science (German program, 7 semester): S			
	Electrical Engineering: Core qualification: Compulsory	,	,	
	General Engineering Science (English program): Specialisation	Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation		nics: Compulsorv	
	General Engineering Science (English program, 7 semester): Sp			pulsory
	General Engineering Science (English program, 7 semester): Sp			. ,
	Computational Science and Engineering: Specialisation Engine			
	Mechatronics: Core qualification: Compulsory	. ,		
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		



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

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



d Design of Mechatronic Systems			
	Тур	Hrs/wk	CP
s (L1822)	Lecture	2	2
Simulation and Design of Mechatronic Systems (L1824) Laboratory 1			2
s (L1823)	Recitation Section (large)	1	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			
	 		
	• •		
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			
Elective 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			
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		
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 [®] and Simulink [®]
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					
itle		Тур	Hrs/wk	СР	
Semiconductor Circuit Design (L0763)		Lecture	3	4	
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2	
Module Responsible	NN				
Admission Requirements	none				
Recommended Previous	Fundamentals of electrical engineering				
Knowledge	Basics of physics				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence	· · · · · · · · · · · · · · · · · · ·				
Knowledge					
1 13	 Students are able to explain the functionality of different 	nt MOS devices in electronic circuits.			
	Students know the fundamental digital logic circuits are	nd can discuss their advantages and disadva	ntages.		
	 Students have solid knowledge about memory circuits 	s and can explain their functionality and speci	fications.		
	 Students are able to explain how analog circuits funct 	ions and where they are applied.			
	 Students know the appropriate fields for the use of bip 	olar transistors.			
Skills	Students can calculate the specifications of different M	MOS devices and can define the parameters of	of electronic circuits		
	Students are able to develop different logic circuits an		relectionic circuits.		
	Students are able to develop unierent logic circuits an Students can use MOS devices, operational amplifiers		anc.		
	Gludents can use MOS devices, operational ampliners	s and bipolar transistors for specific application	J115.		
Personal Competence Social Competence	 Students are able work efficiently in heterogeneous te Students working together in small groups can solve p 		s.		
Autonomy	Students are able to assess their level of knowledge.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following	General Engineering Science (German program): 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)			pulsory	
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program): Specialisat		onics: Compulsory		
	General Engineering Science (English program, 7 semester)	0 0,	, ,		
	General Engineering Science (English program, 7 semester)			oulsory	
	Mechanical Engineering: Specialisation Mechatronics: Comp			•	
	Mechatronics: Core qualification: Compulsory				
	Technomathematics: Core qualification: Elective Compulsory				



Course L0763: Semiconductor Circu	uit Design
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	NN
Language	DE
Cycle	SoSe
Content	 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 From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).
Literature	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo





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	. felles de la contra o			
Educational Objectives	After taking part successfully, students have reached the	e following learning r	esults		
Professional Competence					
Knowledge	Students can name the basic concepts in Mather	matice IV They are a	hle to evolain them using ann	ronriata avamnlas	
	· ·				4h 4h a h a la af aa.a.l
	Students can discuss logical connections between		ney are capable of mustrating	g triese confrections 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	se. Moreover, they are	capable of solving th
	by applying established methods.				
	 Students are able to discover and verify further lo 	ogical connections be	etween the concepts studied i	n the course.	
	 For a given problem, the students can develop a 	and execute a suitable	e approach, and are able to cr	ritically evaluate the re	sults.
Paragnal Compatons					
Personal Competence					
Social Competence	Students are able to work together in teams. The	ev are canable to use	mathematics as a common la	inquage	
	In doing so, they can communicate new concept				can design example
			leeds of their cooperating pa	ruleis. Moreover, uley	can design example
	check and deepen the understanding of their per	ers.			
Autonomy					
	Students are capable of checking their understa	anding of complex co	oncepts on their own. They can	an specify open quest	ions precisely and kr
	where to get help in solving them.				
	 Students have developed sufficient persistence to 	to be able to work for	longer periods in a goal-orie	nted manner on hard p	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 Equa	tions 2)			
Assignment for the Following	General Engineering Science (German program): Speci	ialisation Electrical E	ngineering: Compulsory		
Curricula	General Engineering Science (German program): Speci	ialisation Mechanical	Engineering, Focus Mechatr	onics: Compulsory	
	General Engineering Science (German program): Speci	ialisation Mechanical	Engineering, Focus Theoreti	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (German program): Speci	ialisation Naval Archi	tecture: Compulsory		
	General Engineering Science (German program, 7 sem	ester): Specialisation	Electrical Engineering: Com	pulsory	
	General Engineering Science (German program, 7 sem				mpulsorv
	General Engineering Science (German program, 7 sem				
	Compulsory	outo.j. opetiansa	coamour Engineeling	,, . Jour moorewal r	
	, ,		Name I A calcita at a case of		
	General Engineering Science (German program, 7 sem		•	iory	
	Computer Science: Specialisation Computational Mathe	ematics: Elective Con	npulsory		
	Electrical Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specia	alisation Electrical Er	ngineering: Compulsory		
	General Engineering Science (English program): Specia	alisation Naval Archit	tecture: Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechanica: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory				
	General Engineering Science (English program, 7 seme		-	-	
					nuleon
	General Engineering Science (English program, 7 seme		-		
	General Engineering Science (English program, 7 se	emester): Specialisat	on 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	n Engineering Scienc	es: Elective Compulsory		
	Computational Science and Engineering: Specialisation	-			
	Mechanical Engineering: Specialisation Theoretical Me	•			
	·		g. Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: 0	Compulsory			
	Mechatronics: Core qualification: Compulsory				
	Naval Architecture: Core qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory				



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

Course L1044: Differential Equation	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		



Focus Product Development and Production

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

Module M0597: Advanced	Mechanical Engineering Design				
Courses					
Title		Тур	Hrs/wk	CP	
Advanced Mechanical Engineering Design	n II (I 0264)	Lecture	2	2	
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1	
Advanced Mechanical Engineering Design I (L0262) Lecture 2					
	nced Mechanical Engineering Design I (L0263) Recitation Section (large) 2 1				
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous					
Knowledge	Fundamentals of Mechanical Engineering Design				
· ·	Mechanics				
	Fundamentals of Materials Science				
	Production Engineering				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results			
Professional Competence	The taking part decession, state in the reaction are reaction and the second are	arming roomic			
Knowledge	After passing the module, students are able to:				
Knowledge	After passing the module, students are able to.				
	explain complex working principles and functions of machine	elements and of basic elements of flui	dics,		
	 explain requirements, selection criteria, application scenarios 	and practical examples of complex m	achine elements,		
	 indicate the background of dimensioning calculations. 				
OL III.	After passing the module students are able to				
Skills	After passing the module, students are able to:				
	accomplish dimensioning calculations of covered machine ele	ements,			
	 transfer knowledge learned in the module to new requiremen 	ts and tasks (problem solving skills),			
	 recognize the content of technical drawings and schematic sk 	etches,			
	 evaluate complex designs, technically. 				
D					
Personal Competence					
Social Competence	Students are able to discuss technical information in the lectu	re supported by activating methods.			
Autonomy	Students are able to independently deepen their acquired knowledge.	owledge in exercises.			
	Students are able to acquire additional knowledge and to		ent e.g. by using the	video recordings of	
	lectures.				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120				
Assignment for the Following	General Engineering Science (German program): Specialisation Med	chanical Engineering, Focus Energy S	ystems: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Med				
	General Engineering Science (German program): Specialisation Med	chanical Engineering, Focus Materials	in Engineering Scier	nces: Compulsory	
	General Engineering Science (German program): Specialisation Med				
	General Engineering Science (German program): Specialisation Med	•	•		
	General Engineering Science (German program): Specialisation Med				
	General Engineering Science (German program, 7 semester): Specia		-		
	General Engineering Science (German program, 7 semester): Sp	ecialisation Mechanical Engineering	, Focus Materials ir	Engineering Science	
	Compulsory	Proposition of the contract of			
	General Engineering Science (German program, 7 semester): Specia				
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering,	Focus Product Devel	opment and Producti	
	Compulsory				
	General Engineering Science (German program, 7 semester): Spi	eciansation wechanical Engineering,	rocus ineoretical l	viecrianicai Engineeri	
	Compulsory	lication Manhamian Fasianamian Fasi	Diamashasias. Ca		
	General Engineering Science (German program, 7 semester): Specia	0 0,		, ,	
	General Engineering Science (German program, 7 semester): Specia			ompuisory	
	General Engineering Science (English program): Specialisation Med			Compulsory	
	General Engineering Science (English program): Specialisation Med				
	General Engineering Science (English program): Specialisation Med			ces. Compuisory	
	General Engineering Science (English program): Specialisation Med			Justian: Campulate	
	General Engineering Science (English program): Specialisation Med		·		
	General Engineering Science (English program): Specialisation Mec				
	General Engineering Science (English program, 7 semester): Specia	-	•		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering	, ⊢ocus Materials in	ı ⊨ngıneering Sciend	
	Compulsory	Programme Mandage Control			
	General Engineering Science (English program, 7 semester): Specia	-			
	General Engineering Science (English program, 7 semester): Spe-	cialisation Mechanical Engineering, l	rocus Product Devel	opment and Producti	
	I				



Compulsory

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

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

Naval Architecture, Core qualification, Compulsory

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

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



Course L0262: Advanced Mechanic	al Engineering Design I	
Тур	Lecture	
Hrs/wk	2	
CP	-)	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
	DE	
Language	WiSe	
Cycle		
Content	Advanced Mechanical Engineering Design I & II	
	Lecture	
	Fundamentals of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	Seals	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	Crank drives	
	Sliding bearings	
	Elements of fluidics	
	Exercise	
	Calculation methods of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	• Crank gears	
	Sliding bearings	
	Calculations of hydrostatic systems (fluidics)	
Literature		
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.	
	Sawia waitara Riinhar zu spaziallan Thaman	
	Sowie weitere Bücher zu speziellen Themen	

Course L0263: Advanced Mechanic	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 (L02	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 leaves	earning 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 poss 	ibilities,		
	 explain guidelines for designing for function and manufactur 			
	explain advanced use-oriented knowledge of machine elem			
Skills	After passing the module, students are able to:			
	 analyze complex tasks and develop principle solutions using 	sketches,		
	 convert principle solutions into a detailed design, 	•		
	 use methods to design and solve engineering design tasks 	systematically and solution-oriented	l,	
	create a technical documentation including all necessary technical documentation in the properties of the propertie			
	document calculations of selected machine elements clearly		•	
Personal Competence				
Social Competence	After passing the module, students are able to:			
	present and discuss solutions and technical drawings within groups,			
	reflect the own results in the work groups of the course			
A. (Afternoon to the seed to stude to see this to			
Autonomy	After passing the module, students are able to:			
	independently solve complex design projects, while motivati	ng themselves, acquiring necessar	y knowledge and selectin	g appropriate method
	 to independently solve problems. 			
Worlds of the House	Indexes dead Or of Taxa 404 Or of Taxa in Leading 50			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points Examination	Written exam			
Examination duration and scale	180			
		schonical Engineering Feets Airpre	off Cystoma Engineering	Compulacry
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Me			
Curricula	General Engineering Science (German program): Specialisation Me General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	0 0	•	0 0 1
	Compulsory	ecialisation Mechanical Engineerii	ig, i ocas i rodaci Devel	opinent and i roddel
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineer	ing Focus Theoretical N	Aechanical Engineeri
	Compulsory	secialisation Meditarilear Engineer	mg, roddo medicadar i	Meditallidar Eligilideli
	General Engineering Science (English program): Specialisation Me	chanical Engineering Focus Aircra	ft Systems Engineering: (Compulsory
	General Engineering Science (English program): Specialisation Me			
	General Engineering Science (English program): Specialisation Me	-	·	
	General Engineering Science (English program, 7 semester): Specialisation we	0 0,	o o	0 ,
	General Engineering Science (English program, 7 semester): Special Engineering Science (English program): Special English English Engineering Science (English English Engli	0 0,	•	0 0 1
	Compulsory		.g, . 00000000. Devel	
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engineer	ing. Focus Theoretical M	Mechanical Engineer
	Compulsory		3,	
	• •			



Course L0266: Advanced Mechanic	al Design Project	
Тур	Practical Course	
Hrs/wk		
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	
	Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten	
	Erstellung einer ausführlichen Dokumentation	
	Lösungsfindung	
	Methodische Erarbeitung von prinzipiellen Lösungskonzepten	
	Erstellen einer Dokumentation	
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen 	



Module M0726: Production	Technology			
Courses				
Title		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	internehin recommended			
	internship recommended			
	Previous knowledge in mathematics, mechanics and ele	ctrical engineering		
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students are able to			
	explain the basics of chip formation and mechani	sms and models of machining.		
	explain methods and parameters for design and a		and tools.	
	explain technical concepts of machine tool building			
	explain types, constructions and functions of CNC			
	explain equipment components.	-	,	
Skills	Students are able to			
Onno	olddenia are able to			
	 select tool geometry, cutting materials, process page 	arameters and appropriate measuring technique	e in accordance with the	e requirements.
	estimate occurring forces and temperatures during	· '		
	select appropriate machine tools for machining at	nd create NC programs for turning and milling.		
	assess the quality of a machine tools and to detect	ct weak points.		
Personal Competence				
Social Competence	Students are able to			
	 develop solutions in a production environment with qualified personnel at technical level and represent decisions. 			
Autonomy	Students are able to			
Autonomy	Students are able to			
	 interpret independently cutting processes. 			
	 create independently NC programs. 			
	select independently machine tools by reference	to appropriate requirements.		
	 assess own strengths and weaknesses in general 	ıl.		
	 assess their learning progress and define gaps to 	be improved.		
	assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specia	alisation Mechanical Engineering, Focus Produc	ct Development and Pro	oduction: Compulsory
Curricula	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanical Engineering	g, Focus Product Deve	lopment and Product
	Compulsory			
	General Engineering Science (English program): Specia	lisation Mechanical Engineering, Focus Produc	t Development and Pro	duction: Compulsory
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engineering	g, Focus Product Deve	lopment and Product
	Compulsory			
	I			
	Mechanical Engineering: Specialisation Product Develop	oment and Production: Compulsory		



Typ Lecture Hrs/wk 3 CP 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 Literature Conrad, K.J.
Hrs/wk 3 CP 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
CP 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
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
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
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NC programming and NC programming systems Types, construction and function of CNC machines Multi-machinesystems Equipmentcomponents for machine tools Assessment of machine tools
Types, construction and function of CNC machines Multi-machinesystems Equipmentcomponents for machine tools Assessment of machine tools
Multi-machinesystems Equipmentcomponents for machine tools Assessment of machine tools
Equipmentcomponents for machine tools Assessment of 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
Work Manfred
Weck, Manfred Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
ISBN: 9783540225041
Berlin [u.a.]: Springer, 2005
Weck, Manfred; Brecher, Christian
Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
ISBN: 3540225072
Berlin [u.a.]: Springer, 2006
Weck, Manfred; Brecher, Christian
Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
ISBN: 3540225056
Berlin [u.a.]: Springer, 2006



Course L0613: Forming and Cutting	Technology
Тур	Lecture
Hrs/wk	2
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 <i>Massivumformung</i> , 4. Auflage, VDI-Verlag (1996) König, W., Klocke, F.; Fertigungsverfahren Bd. 5 <i>Blechbearbeitung</i> , 3. Auflage, VDI-Verlag (1995) Klocke, F., König, W.; Fertigungsverfahren <i>Schleifen, Honen, Läppen</i> , 4. Auflage, Springer Verlag (2005) König, W., Klocke, F.: Fertigungsverfahren <i>Drehen, Fräsen, Bohren</i> , 7. Auflage, Springer Verlag (2002)

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



Module M1009: Material Sci	ence Laboratory			
Courses				
Title		Тур	Hrs/wk	СР
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)	D (D E	Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler none			
Admission Requirements Recommended Previous	none			
Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following	learning regulte		
•	After taking part successionly, students have reached the following	learning results		
Professional Competence Knowledge	Students are able to give a summary of the technical details of exp	oriments in the area of materials sais	noos and illustrato rooms	otivo rolationshins. They
Knowieage	are capable of describing and communicating relevant problems		·	, ,
	process of solving practical problems and present related results.	s and questions using appropriate te	cillical language. They	can explain the typical
	process or solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on materi	al sciences to the process of solving	practical problems. The	y identify and overcome
	typical problems during the realization of experiments in the context 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 preser			
cona. competence	and explain their results alone or in groups in front of a qualified audience.			
Autonomy	Students are capable of solving problems in the context of materi		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 N	lechanical Engineering, Focus Materi	als in Engineering Scien	ces: Compulsory
Curricula	General Engineering Science (German program): Specialisation N	lechanical Engineering, Focus Produ	ct Development and Proc	luction: Compulsory
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineer	ring, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Specialisation M	•		
	General Engineering Science (English program): Specialisation M			
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	Compulsory	I Dun divetions Comme to the		
	Mechanical Engineering: Specialisation Product Development and			
	Mechanical Engineering: Specialisation Materials in Engineering S		iva Campula	
	Product Development, Materials and Production: Technical Comple	ementary Course Core Studies: Elect	ive Compulsory	

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



Course L1235: Material Science Laboratory		
Тур	Laboratory Course	
Hrs/wk	4	
CP	4	
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56	
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller	
Language	DE	
Cycle	WiSe	
Content	8 Versuche:	
	Zustandsdiagramm, Wärmebehandlung, Härtemessung	
	Kerbschlagbiegeversuch	
	Vorgänge bei der Erstarrung von Metallen	
	Zugversuch	
	Identifizierung von Kunststoffen	
	Faserverstärkte Kunststoffe	
	Herstellung und Gefüge keramischer Werkstoffe	
	Mechanisches Verhalten keramischer Werkstoffe	
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II	



Module M0599: Integrated I	Product Development and Lightweight 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
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 fol	lowing learning results	<u>-</u>	
Professional Competence Knowledge	After completing the module, students are capable of:			
ruiemeage	explaining the functional principle of 3D-CAD-Syster	ma DDM and EEM Systems		
	describing the interaction of the different CAE-System			
Skills				
	After completing the module, students are able to:			
	Aller completing the module, students are able to.			
	evaluate different CAD- and PDM-Systems with regard decimals and approximately services of the services o		cation schemes and	product structuring
	 design an exemplary product using CAD-,PDM- and 	or FEM-Systems with snared workload		
B				
Personal Competence Social Competence	After completing the module, students are able to:			
oociai oompetence	Alter 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:			
	independently adapt to a CAE-Tool and complete a	given practical task with it		
ANT-LILE AND AN		•		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination Examination duration and scale	90			
Examination duration and scale		ation Manharian Francisco Francis Aircraft Co		0
Assignment for the Following Curricula	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 semesters)		•	
	Compulsory	, -p		.,
	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			
	Mechanical Engineering: Specialisation Product Developm	ent and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems En			
	Product Development, Materials and Production: Technical	Complementary 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	 Practical Introduction in the used software systems (Creo, Windchill, Hyperworks) Team formation, allocation of tasks and generation of a project plan Collective creation of one product out of CAD models supported by FEM calculations and PDM system Manufacturing of selected parts using 3D printer Presentation of results Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.
Literature	-

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

Course L0269: Integrated Product Development I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	SoSe	
Content	Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X	
Literature	 Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag 	



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.

mathematics and heat transfer, such that a continuous study in the Master program in Theoretical Mechanical Engineering is possible. Module M0597: Advanced Mechanical Engineering Design				
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering Design	II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design	II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering De	sign		
Knowledge	Mechanics			
	 Fundamentals of Materials Science 			
	 Production Engineering 			
Educational Objectives	After taking part successfully, students have reached	the following learning recults		
	After taking part successiony, students have reached	the following learning results		
Professional Competence	After passing the module, students are able to:			
Knowledge	After passing the module, students are able to.			
	 explain complex working principles and function 	ions of machine elements and of basic elements of flu	iidics,	
	 explain requirements, selection criteria, applic 	cation scenarios and practical examples of complex r	nachine elements,	
	 indicate the background of dimensioning calc 	ulations.		
Skills	After passing the module, students are able to:			
	passing are meaning, steel and are the			
	accomplish dimensioning calculations of cover			
		new requirements and tasks (problem solving skills),		
	recognize the content of technical drawings at	nd schematic sketches,		
	 evaluate complex designs, technically. 			
Personal Competence				
Social Competence				
	Students are able to discuss technical information	ation in the lecture supported by activating methods.		
Autonomy				
	Students are able to independently deepen the			
	· ·	wledge and to recapitulate poorly understood cont	ent e.g. by using the	video recordings of
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 1	12		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Sp	ecialisation Mechanical Engineering, Focus Energy	Systems: Compulsory	
Curricula	General Engineering Science (German program): Sp	ecialisation Mechanical Engineering, Focus Aircraft S	Systems Engineering:	Compulsory
	General Engineering Science (German program): Sp	ecialisation Mechanical Engineering, Focus Material	s in Engineering Scie	nces: Compulsory
	General Engineering Science (German program): Sp			
	General Engineering Science (German program): Sp			
	General Engineering Science (German program): Sp		-	
	General Engineering Science (German program, 7 se		•	
	General Engineering Science (German program, 7 Compulsory	/ semester): Specialisation Mechanical Engineerin	g, Focus Materials I	n Engineering Science
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engineering Fo	cue Machatronice: Co	mouleon
	General Engineering Science (German program, 7 Science)			
	Compulsory	composition, openial case in mornal length coming,		nopmont and 1 rodge.
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engineering	. Focus Theoretical	Mechanical Engineeri
	Compulsory	, ,		
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engineering, Fo	cus Biomechanics: Co	ompulsory
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engineering, Fo	cus Energy Systems:	Compulsory
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Energy S	systems: Compulsory	
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Materials	in Engineering Scier	nces: Compulsory
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Product I	Development and Pro	duction: Compulsory
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (English program, 7 se	, ,	•	
	General Engineering Science (English program, 7	semester): Specialisation Mechanical Engineerin	g, Focus Materials in	n Engineering Science
	Compulsory			
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program, 7	semester): Specialisation Mechanical Engineering,	Focus Product Deve	nopment and Producti
	Compulsory			



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

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

Naval Architecture: Core qualification: Compulsory

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

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



Course L0262: Advanced Mechanic	al Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
	DE
Language	WiSe WiSe
Cycle	
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Debat Trade de Cada Markinska Oska K II Falkana (KIII) Osian Watan da II A Z
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinanalamanta Board Lille Niemana G. Carinana Verlag, aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente: Steinhilper. W., Röper. R., Springer Verlag, aktuelle Auflage.
	, , , , , , , , , , , , , , , , , , ,
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - 2, Schlecht, B., Fearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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



Courses				
Fitle	00)	Typ	Hrs/wk	СР
Advanced Mechanical Design Project (L02		Practical Course	4	6
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Mechanical Engineering: Design			
Knowledge	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the follow	wing loorning recults		
Professional Competence	After taking part successium, students have reached the lond	wing learning results		
Knowledge	After passing the module, students are able to:			
Milowieage	Alter passing the module, students are able to.			
	 express the procedure for systematically handling of 			
	 complex design tasks , 			
	 describe working principles, their use and combination 	n possibilities,		
	 explain guidelines for designing for function and manu 			
	 explain advanced use-oriented knowledge of machine 	elements.		
Skills	After passing the module, students are able to:			
	analyze complex tasks and develop principle solutions analyze taring and a solutions into a detailed design.	s using sketches,		
	 convert principle solutions into a detailed design, use methods to design and solve engineering design: 	tacks systematically and solution oriented		
	 create a technical documentation including all necess. 			
	document calculations of selected machine elements of the sel		difficulties of the system,	
	a document calculations of schooled machine cicinents of	sourify and in dotain.		
Personal Competence				
Social Competence	After passing the module, students are able to:			
	 present and discuss solutions and technical drawings 	within groups		
	reflect the own results in the work groups of the course			
	Telloge the own results in the work groups of the course			
Autonomy	After passing the module, students are able to:			
	 independently solve complex design projects, while m 	otivating themselves, acquiring necessary	v knowledge and selectin	a appropriate method
	to independently solve problems.	ouvaing memserves, acquiring necessary	y Knowledge and selectin	g appropriate metrous
	to macponatinal, conto prostonio.			
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): Specialisati			
Curricula	General Engineering Science (German program): Specialisati		·	
	General Engineering Science (German program): Specialisati			
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engineering	ng, Focus Product Devel	opment and Production
	Compulsory	A. O. otaliana Markania Francisco	in Francisco Theory Paul N	Acaba ataut Easta as
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineer	ing, Focus Theoretical N	nechanicai Engineeni
	Compulsory	an Machaniaal Engineering Feetin Aircra	ft Systems Engineering: (`amaulaan
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester):		-	
	General Engineering Science (English program, 7 semester): General Engineering Science (English program, 7 semester):		•	
	Compulsory	.,. opodianoanon meditatiidat Engineeni	ig, i ocas i iodaci Devel	opinent and Froudclit
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engineer	ing Facus Theoretical N	Mechanical Engineering
	Constant Linguistering Colonico (Linguisti program, 7 Sellieste	,. opoolalioation mountainoat Engineen	, i oodo illoolottoal IV	
	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
	 Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
	 Erstellung einer ausführlichen Dokumentation
	Lösungsfindung
	 Methodische Erarbeitung von prinzipiellen Lösungskonzepten
	Erstellen einer Dokumentation
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen



Module M0684: Heat Trans	jer			
module moody. Heat Halls				
Courses				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followin	g 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	approach.		
Autonomy	The students are able to develop a complex problem self-consis	ent and analyse the results in a critical wa	y. A qualified exchan	ge with other students is
	given.			
Wayldood in Harra	Independent Chiele Time 110 Chiele Time in London 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			
Curricula	General Engineering Science (German program): Specialisation		ystems: Compulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering,	Focus Theoretical N	Mechanical Engineering
	Compulsory			
	General Engineering Science (German program, 7 semester): Sp		pulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	* *		
	General Engineering Science (English program): Specialisation	0 0, ,	, ,	
	General Engineering Science (English program): Specialisation		•	
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Compulsory	Specialisation Mechanical Engineering,	Focus Theoretical N	Mechanical Engineering
	General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compu		-	
	Mechanical Engineering: Specialisation Theoretical Mechanical			
	0 0 ,	5 0 1 7		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



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



Module M1320: Simulation	and Design of Mechatronic Systems			
•				
Courses				
Title		Тур	Hrs/wk	CP
Simulation and Design of Mechatronic Sys		Lecture	2	2
Simulation and Design of Mechatronic Sys		Laboratory	1	2
Simulation and Design of Mechatronic Sys		Recitation Section (large)	1	2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and electrical engineering	1		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for design, mo	deling, simulation and optimization	of mechatronic system	is.
Skills	Students are able to apply modern algorithms for modeling of me	chatronic systems. They can ident	tify, simulate and desi	ign simple systems and
	implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups and pre	econt recults to target groups		
30ciai Competence	Students are able to work goar-oriented in small mixed groups and pre	sent results to target groups.		
Autonomy	Students are able to recognize and improve knowledge deficits indepe	endently.		
	With instructor assistance, students are able to evaluate their own kno	wladge level and define a further co	ureo of study	
Workload in Hours	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination	Written exam			
Examination duration and scale	90 min			
		and a first transfer of the Market		
Assignment for the Following	General Engineering Science (German program): Specialisation Mech			2
Curricula	General Engineering Science (German program): Specialisation Mech			
	General Engineering Science (German program): Specialisation Mech		-	
	General Engineering Science (German program, 7 semester): Special			
	General Engineering Science (German program, 7 semester): Special		•	
	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering	g, Focus Theoretical N	Mechanical Engineering:
	Elective Compulsory			
	General Engineering Science (English program): Specialisation Mech	anical Engineering, Focus Aircraft S	Systems Engineering: C	Compulsory
	General Engineering Science (English program): Specialisation Mech	anical Engineering, Focus Mechatro	onics: Compulsory	
	General Engineering Science (English program): Specialisation Mech	anical Engineering, Focus Theoretic	cal Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester): Speciali	sation Mechanical Engineering, Foo	cus Mechatronics: Com	pulsory
	General Engineering Science (English program, 7 semester): Speciali	sation Mechanical Engineering, Foo	cus Aircraft Systems Er	gineering: Compulsory
	General Engineering Science (English program, 7 semester): Spec	cialisation Mechanical Engineering	, Focus Theoretical N	Mechanical Engineering:
	Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems Engineering	Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Compulsory			
	Mechanical Engineering: Specialisation Theoretical Mechanical Engin	neering: Compulsory		
	Mechatronics: Core qualification: Compulsory	•		
	mosnatornos. Soro qualification. Comparisory			

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 [®] and Simulink [®]	
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 M0854: Mathematic	es IV			
Courses				
Title		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	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)	T	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 follo	owing learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge				
Knowieuge	Students can name the basic concepts in Mathematic	s IV. They are able to explain them using appro	priate examples.	
	Students can discuss logical connections between the	ese concepts. They are capable of illustrating t	nese connections w	ith the help of examples.
	 They know proof strategies and can reproduce them. 			
	, p g g a a a			
Skills	Students can model problems in Mathematics IV with	the help of the concents studied in this source	Moreover thou are	canable of coluing than
	-	the help of the concepts studied in this course	. woreover, triey are	capable of solving ther
	by applying established methods.			
	Students are able to discover and verify further logical	I connections between the concepts studied in	the course.	
	For a given problem, the students can develop and ex	recute a suitable approach, and are able to criti	cally 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 land	guage.	
	In doing so, they can communicate new concepts act			can design examples to
		cording to the fleeds of their cooperating part	iers. Moreover, triey	can design examples t
	check and deepen the understanding of their peers.			
Autonomy				
	Students are capable of checking their understanding	g of complex concepts on their own. They car	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-oriente	ed manner on hard	oroblems.
Worklood in House	Independent Study Time 68, Study Time in Lecture 112			
	- Independent Study Time 66, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equations	2)		
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa		ics: Compulsorv	
	General Engineering Science (German program): Specialisa			eering: Compulsory
		• •		compulsory
	General Engineering Science (German program): Specialisa	• •	la con	
	General Engineering Science (German program, 7 semester		-	
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engineering,	Focus Theoretical I	Mechanical Engineering
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsor	у	
	Computer Science: Specialisation Computational Mathemati			
	Electrical Engineering: Core qualification: Compulsory	,		
		ion Floatsiaal Factor of the O		
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat	ion Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Mechatron	ics: Compulsory	
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Theoretica	Mechanical Engine	eering: Compulsory
	General Engineering Science (English program, 7 semester)	: Specialisation Electrical Engineering: Comput	sory	
	General Engineering Science (English program, 7 semester)			npulsory
	General Engineering Science (English program, 7 semester)			
		ion, opecialisation internation Engineering,	i ocus ineoretical I	weenamear Engineering
	Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Naval Architecture: Compulsor	/	
	Computational Science and Engineering: Specialisation Eng	ineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisation Cor	nputer Science: Elective Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mechan	•		
	Mechanical Engineering: Specialisation Mechatronics: Compulsory			
		,		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



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

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

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

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



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

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



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)	330)	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 fo	llowing learning results		
Professional Competence				
Knowledge	After passing this module the students have the ability to:			
	a give an evention of the most important fields on pro	coses and highrocoses anginogring		
	give an overview of the most important fields on pro overlain come working methods for different fields in			
	 explain some working methods for different fields in 	process engineering.		
Skills	After passing this module the students should have the abi	lity to:		
	Patricial and the state of the	and the state of		
	list and outline the most important fields of process			
	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 wastew			
	 scheme typical chemical and biotechnological proc 	esses independently with the aid of point	ers.	
Personal Competence				
Social Competence	The students are able to			
	a consideration of the form of the constant of			
	work out results in groups and document them,			
	 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 Pro	ocess Engineering and
	Bioprocess Engineering.			
Westers are to	Independent Chally Time OA Chall Time Independent			
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	Written exam			
Examination				
Examination duration and scale	90 min	- The Breeze Fred Co.		
Assignment for the Following	General Engineering Science (German program): Specialis			
Curricula	General Engineering Science (German program): Specialis			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 semest	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	er): 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	iterial engineering
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.



Module M0937: Physical Cl	nemistry			
Courses				
Title		Тур	Hrs/wk	CP
Physical Chemistry (L0833) Physical Chemistry (L0835)		Lecture Laboratory Course	2	2
Module Responsible	Prof. Hans-Ulrich Moritz	Laboratory Course	2	'
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemistry, physics to	or engineers and mathematics I-III		
Knowledge	Contents of the previous modules morganic shormstry, physics i	or origineers and mathematics i in:		
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 3		
Knowledge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-,	neat- and momentum transfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.			
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and	kinetic calculations.		
	- assess new applications with respect to environmental sustain	nability.		
	- abstract their knowldege to related issues to conduct thermody	namical, electrochemical and kinetic ca	lculations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and document of	experiments according to scientific guide	elines in small groups.	
	The students are able to reflect their subject-specific knowledge	orally in a team and to discuss it with fe	ellow students and faculty	<i>'</i> .
Autonomy	Students are able to assess their knowldege continuously on the	eir own by exemplified practice. Studer	nts are able to apply thei	r knowldege discretely to
	plan, prepare and conduct experiments.			
Washland in House	Independent Study Time 24 Study Time in Lecture 56			
Workload in Hours Credit points	Independent Study Time 34, 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 Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): S		mpulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Bioprocess Engineering: E	Elective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsor	у		
	General Engineering Science (English program): Specialisation	Process Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Process Engineering: Com	npulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Bioprocess Engineering: E	Elective Compulsory	
	Process Engineering: Core qualification: Compulsory			

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



Course L0835: Physical Chemistry	
Тур	Laboratory Course
Hrs/wk	2
СР	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



one Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration Iter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds explain simplifications of the Continuity- and Navier-Stokes	Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 4 2
Mathematics I+II+IIII Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration ter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	Lecture Recitation Section (large)	2	4
Mathematics I+II+IIII Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration ter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	Lecture Recitation Section (large)		
Mathematics I+II+IIII Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration ter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds		2	2
Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration Iter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	learning results		
Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration ter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	learning results		
Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration ter taking part successfully, students have reached the following udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	learning results		
udents are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds	learning results		
explain the difference between different types of flow give an overview for different applications of the Reynolds			
ne students are able to	- Equation by coming projects about the control of		
 describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 			
ne students			
 are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small groexercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results. The students are able to search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. 			
dependent Study Time 124. Study Time in Lecture 56			
ritten exam			
hours			
eneral Engineering Science (German program): Specialisation E eneral Engineering Science (German program): Specialisation E eneral Engineering Science (German program, 7 semester): Specialisation E eneral Engineering Science (German program, 7 semester): Specialisation E eneral Engineering Science (German program, 7 semester): Specialisation: Compulsory opporcess Engineering: Core qualification: Compulsory eneral Engineering Science (English program): Specialisation E eneral Engineering Science (English program): Specialisation E eneral Engineering Science (English program): Specialisation P eneral Engineering Science (English program, 7 semester): Specialisation P eneral Engineering Science (English program, 7 semester): Specialisering Sci	control of the contro	ulsory mpulsory gineering: Compulso ompulsory ulsory npulsory	
	search further literature for each topic and to expand their k work on their exercises by their own and to evaluate their a dependent Study Time 124, Study Time in Lecture 56 dependent Study Time 124, Study Time in Lecture 56 dependent Study Time 124, Study Time in Lecture 56 dependent Engineering Science (German program): Specialisation Eneral Engineering Science (German program): Specialisation Eneral Engineering Science (German program): Specialisation Eneral Engineering Science (German program, 7 semester): Specialisation Eneral Engineering Science (German program, 7 semester): Specialisation Engineering Science (German program, 7 semester): Specialisation: Compulsory the semental Engineering: Core qualification: Compulsory the semental Engineering Science (English program): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Poperal Engineering Science (English program, 7 semester): Specialisation III. Engineering Science: Electors (English program, 8 semester): Specialisation III. Engineering Science: Electors (English program, 9 semester): Specialisation III. Engineering Science: Electors (English program, 9 semester): Specialisation III. Engineering Science: Electors (English program, 9 semester): Specialisation III.	search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. dependent Study Time 124, Study Time in Lecture 56 dependent Study Time 124, Study Time in Lecture 56 dependent Engineering Science (German program): Specialisation Process Engineering: Compulsory eneral Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory eneral Engineering: Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering: Core qualification: Compulsory eneral Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program): Specialisation Process Engineering: Compulsory eneral Engineering Science (English program): Specialisation Process Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English p	search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. Idependent Study Time 124, Study Time in Lecture 56 Initiation exam Incomparison of Science (German program): Specialisation Process Engineering: Compulsory eneral Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering: Core qualification: Compulsory eneral Engineering: Core qualification: Compulsory eneral Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program): Specialisation Process Engineering: Compulsory eneral Engineering Science (English program): Specialisation Process Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Speciali



Course L0091: Fundamentals of Flu	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	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: München, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

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



Module M0544: Phase Equi	libria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	СР
Phase Equilibria Thermodynamics (L0114)		Lecture	2	2
Phase Equilibria Thermodynamics (L0140)		Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (L0142)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Thermodynamics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	 Starting from the very basics of thermodynamics, the They learn how state variables are influenced by the Moreover, the students learn how phase equilibria cliquid, solid) coexist in equilibrium. Furthermore the f For different phase equilibria, several examples rele interpreting the equilibria are taught. 	mixing of compounds and learn concepts to quan be described mathematically and which pheundamentals of reaction equilibria are taught.	antitatively describe	these properties. f different phases (vapor,
Skills	 Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how simplify these equations meaningfully. The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve resulting mathematical relations. For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameter literature sources. Beside pure compound properties the students are capable of describing the properties of mixtures. The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena. Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reac processes in chemical engineering. 		ney are able to solve the l as model parameters in a.	
Personal Competence Social Competence Autonomy	The students are able to work in small groups, to solve the corresponding problems and to present them orally to the tutors and other students			
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	all a Brown Ford		
Assignment for the Following	General Engineering Science (German program): Specialisa			
Curricula	General Engineering Science (German program): Specialisa		looni	
	General Engineering Science (German program, 7 semeste General Engineering Science (German program, 7 semeste			
		i). Opecialisation bioprocess Engineering: Com	ιραιουι γ	
	Bioprocess Engineering: Core qualification: Compulsory	tion Bioprocess Engineering: Compulsors		
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program): Specialisa		conv	
	General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester		-	
	Process Engineering: Core qualification: Compulsory	,. opeo.anaaton bioprocess Engineenilg. Com	pulsory	



Course L0114: Phase Equilibria The	rmodynamics
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	
Literature	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 ^E -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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course L0140: Phase Equilibria The	
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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Course L0142: Phase Equilibria The	rmodynamics	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	dependent 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	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 	



ourses				
tle		Turn	Hrs/wk	CD
		Typ Lecture	ars/wk	CP 4
gnals and Systems (L0432) gnals and Systems (L0433)		Recitation Section (large)	3 1	2
Module Responsible	Prof. Gerhard Bauch		<u> </u>	
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	Watternates 1 0			
	The modul is an introduction to the theory of signals and systems. Goo Further experience with spectral transformations (Fourier series, Fourier t			nematik 1-3 is expe
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-in-	variant (LTI) systems using meth	ods of signal and syste	em theory. They are
	to apply the fundamental transformations of continuous-time and discrete	-time signals and systems. They	can describe and analy	yse deterministic si
	and systems mathematically in both time and image domain. In particular, \ensuremath{S}	ılar, they understand the effects	in time domain and in	mage domain whic
	caused by the transition of a continuous-time signal to a discrete-time sig	nal.		
Skills	The students are able to describe and analyse deterministic signals and	linear time-invariant systems us	sing methods of signal a	and system theory.
	can analyse and design basic systems regarding important properties su	uch as magnitude and phase res	sponse, stability, lineari	ity etc They can a
	the impact of LTI systems on the signal properties in time and frequency of	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 con	trol their level of know	ledge during the le
	period by solving tutorial problems, software tools, clicker system.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
		-l Fasianasiana Cassasilana		
Assignment for the Following	General Engineering Science (German program): Specialisation Electrica			
Curricula	General Engineering Science (German program): Specialisation Comput			
	General Engineering Science (German program): Specialisation Process			
	General Engineering Science (German program): Specialisation Bioproc		ampulaan.	
	General Engineering Science (German program): Specialisation Civil- an		Jilipuisory	
	General Engineering Science (German program): Specialisation Mechan			
	General Engineering Science (German program): Specialisation Biomed		nulcon/	
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
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	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisa			
	General Engineering Science (German program, 7 semester): Special Compulsory	ansauon Mechanicai Engineeni	ig, Focus Materials in	Engineering Scie
	General Engineering Science (German program, 7 semester): Specialisa	tion Mechanical Engineering Fo	ocus Mechatronics: Con	nnulsory
	General Engineering Science (German program, 7 semester): Specialisa			
	Compulsory		,, . ocas medicilical IV	
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	d Enviromental Engeneering: Co	ompulsory	
	General Engineering Science (English program): Specialisation Bioproce		p	
	General Engineering Science (English program): Specialisation Electrica			
	General Engineering Science (English program): Specialisation Computer	0 0 1 7		
	General Engineering Science (English program): Specialisation Mechani			
	General Engineering Science (English program): Specialisation Biomedi			
	General Engineering Science (English program): Specialisation Process			
	General Engineering Science (English program, 7 semester): Specialisate		pulsory	
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			npulsory
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisat			
	General Engineering Science (English program, 7 semester): Specialisation			
	Compulsory		g, . 1115 materials III	
	General Engineering Science (English program, 7 semester): Specialisat	ion Mechanical Engineering For	cus Mechatronics: Com	npulsorv
	General Engineering Science (English program, 7 semester): Specialisations of the semester of			
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l				
	Compulsory Computational Science and Engineering: Core qualification: Compulsory	,		



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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				
Title		Тур	Hrs/wk	СР
Informatics for Process Engineers (L0836		Lecture	2	2
Informatics for Process Engineers (L0837		Recitation Section (small)	2	2
Numeric and Matlab (L0125)		Laboratory Course	2	2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements	None.			
Recommended Previous	Basic knowledge in using MS Windows.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students can describe procedural and object-oriented concep	ts.		
Skills	Students are capable of object-oriented programming in the pr	rograming language, lava and of solving ma	athematic questions b	v using Matlah
S.i.iii	oragina are capable or object one near programming in the pr	og.ag language out and or coming me		y doing madab.
	Students are capable of developing concepts (simple algorithm	ns) to solve technical questions.		
Personal Competence				
Social Competence	Students are able to work out solutions together in small group	ns.		
Coolai Competence	Cladente are able to work out solutions together in small group			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Process Engineering: Elective Compulso	ory	
Curricula	General Engineering Science (German program, 7 semester):			ompulsory
	General Engineering Science (German program, 7 semester):			
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Co	ompulsory		
	General Engineering Science (English program): Specialisation	on Process Engineering: Elective Compulso	ry	
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Enviromental En	gineering: Elective Co	ompulsory
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Electiv	e Compulsory	
	Process Engineering: Core qualification: Compulsory			



Course L0836: Informatics for Proce	ess Engineers
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	Introduction to object-oriented modelling and programming exemplified with Java
	 Objects, classes Methods, properties Inheritance Basics of the language Java Sample application: Simulation of an electricity network 2D graphics Events and Controls
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: 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



Module M0938: Bioprocess	Engineering - Fundamentals			
Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Engineering - Fundamentals (I	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 "fundamentals for proc	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 bioproces			
	microorganisms, as well as to differentiate different types of inhib			
	processes in bioreactors can be explained. The students are c	apable to explain fundamental bioproces	ss management, ste	rilization technology and
	downstream processing in detail.			
Skills	After successful completion of this module, students should be ab	le to		
	•			
	describe different kinetic approaches for growth and subst			
	predict qualitatively the influence of energy generation, reg		th inhibition on the fe	rmentation process
	analyze bioprocesses on basis of stoichiometry and to set distinguish between scale up gritaria for different bioscapt		as well as misrosor	ahia) ta aamnara tham aa
	 distinguish between scale-up criteria for different bioreact well as to apply them to current biotechnical problem 	ors and bioprocesses (anaerobic, aerobic	as well as illicidaeli	obic) to compare them as
	propose solutions to complicated biotechnological problet	ne and to deduce the corresponding mode	ale	
	propose solutions to complicated biotechnological problem	ns and to deduce the corresponding mode	313	
	 to explore new knowledge resources and to apply the new 	ly gained contents		
	 identify scientific problems with concrete industrial use and 	d to formulate solutions.		
	 to document and discuss their procedures as well as result 	ts in a scientific manner		
Personal Competence				
Social Competence	After completion of this module participants should be able to de		to enhance the abilit	y to take position to their
	own opinions and increase their capacity for teamwork in enginee	ring and scientific environments.		
Autonomy	After completion of this module participants will be able to solv	e a technical problem in a team indepe	ndently by organizir	ng their workflow and to
•	present their results in a plenum.			
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			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): Sp		•	
	General Engineering Science (German program, 7 semester): Sp	ecialisation Bioprocess Engineering: Com	pulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation E			
	General Engineering Science (English program): Specialisation F		2011	
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Specialisation Artificial Organs and Reg	, , , , , , , , , , , , , , , , , , , ,	Juistry	
	Biomedical Engineering: Specialisation Artificial Organs and Reg Biomedical Engineering: Specialisation Implants and Endoprosth			
	Biomedical Engineering: Specialisation Implants and Endoprostri Biomedical Engineering: Specialisation Medical Technology and			
	Biomedical Engineering: Specialisation Medical Technology and Biomedical Engineering: Specialisation Management and Busine			
	Technomathematics: Specialisation III. Engineering Science: Elec			
	Process Engineering: Core qualification: Compulsory	paco. ;		
	and the second s			



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

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

Course L0843: Bioprocess 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	The second of th			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence	The aliming part decesses any, eladerne nave reaction and is	5.10 m.ng .00 m.ng .00 m.ng		
Knowledge	With the completion of this module the students acquire in	a-denth knowledge of important cause-effect ch	ains of notential enviro	nmental problems whi
Knowledge	might occur from production processes, projects or constru			
	in dealing with different methods and instruments to asset environmental processes as well as uncertainties and diffi		its are able to estimate	the complexity of the
Chille	·		-4	
Skills				
	solutions for managing and mitigating environmental pr			
	independently and can apply the software programs Open to critically judge research results or other publications on		g the course the stude	nts have the competen
	to critically judge research results of other publications of	environmental impacis.		
Personal Competence				
Social Competence	The students are able to discuss the various technical ar	nd scientific tasks, both subject-specific and mu	ultidisciplinary. They ar	re able to develop join
	different solutions and to discuss their theoretical or prac-	tical implementation. Due to the selected lectu	re topics, the students	receive insights into
	multi-layered issues of the environment protection and the	he concept of sustainability. Their sensitivity a	and consciousness tow	vards these subjects a
	raised and which helps to raise their awareness of their fut	ture social responsibilities in their role as engin	eers.	
Autonomy	The students learn to research, process and present a so	cientific topic independently. They are able to	carry out independent	scientific work. They ca
	solve an environmental problem in a business context and	d are able to judge results of other publications.		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Speciali	isation Energy and Environmental Engineering: (Compulsory	
Curricula	General Engineering Science (German program): Speciali			
241104114	General Engineering Science (German program, 7 semes			v
	General Engineering Science (German program, 7 semes			,
	General Engineering Science (German program, 7 semes			
	Bioprocess Engineering: Core qualification: Elective Comp			
1	Energy and Environmental Engineering: Core qualification	•		
	General Engineering Science (English program): Specialis		Compulsory	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semest		•	/
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	General Engineering Science (English program 7 semest	er): Specialisation Process Engineering: Flective	e Compulsory	
	General Engineering Science (English program, 7 semesti General Engineering Science (English program, 7 semesti			
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest Process Engineering: Core qualification: Elective Compuls	er): Specialisation Bioprocess Engineering: Ele		



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

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



Module M0538: Heat and M	lass Transfer
Courses	
Courses	Tun Hrahul CB
Title Heat and Mass Transfer (L0101)	Typ Hrs/wk CP Lecture 2 2
Heat and Mass Transfer (L0102)	Recitation Section (small) 1 2
Heat and Mass Transfer (L1868)	Recitation Section (large) 1 2
Module Responsible	Prof. Irina Smirnova
Admission Requirements	None
Recommended Previous	
Knowledge	
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 to the control of the contr
	chemical reactors).
	 They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermaliation.
	The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative because of the students have the students
	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.
Skills	The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the
	corresponding energy and mass flow, respectively.
	They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the
	corresponding heat flows.
	Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus.
	They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description
	and design of apparatus (e.g. extraction column, rectification column).
	• In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application
	considering their advantages and disadvantages, respectively.
	In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.
	The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the course)
	thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.
Personal Competence	
Social Competence	The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors an
	other students.
	Salar
Autonomy	
Adionomy	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-like).
	assignments) and on this basis they can control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	120 minutes; theoretical questions and calculations
Assignment for the Following	
Assignment for the Following	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
Curricula	
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental 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): 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
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	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 (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
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	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, 7 semester): 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 General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
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Course L0101: Heat and Mass Transfer	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas

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

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



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	2	2
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)	Dref him a Casima area	Laboratory Course	1	1
Module Responsible Admission Requirements	Prof. Irina Smirnova None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followin	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 select They have good knowledge of designing methods for sep	f concentration during a separation proce on of separation systems		
Skills	Using the gained knowledge the students can select a reenergy and material balances The students can use different graphical methods for the context of the students are capable to obtain independently the new the students are capable to obtain independently the new they can calculate continuous and discontinuous process The students are able to prove their theoretical knowledge. The students are able to discuss the theoretical backgrous. The students are capable of linking their gained knowledge with the other lectures such as thermodynamics, fluid mechanics and chemical students are capable.	designing of a separation process and defi aration process for a given case based of ded material properties from appropriate s ses in the experimental lab work. Indiginal and the content of the experimental work.	ne the amount of the on the advantages a sources (diagrams an	pretical 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 gro The students are able to carry out practical lab work in si			n them. They are able to
	discuss their results and to document them scientifically in	a report.		
Autonomy	The students are capable to obtain the needed informatio The students can proof the state of their knowledge with e			ing process
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation	Process Engineering: Compulsory	<u></u>	
Curricula	General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp	ecialisation Energy and Enviromental Eng	ineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Com	•		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	• •	mpulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp			_
	General Engineering Science (English program, 7 semester): Sp	eciansation Energy and Enviromental Eng	meening: Compulsory	1
	Process Engineering: Core qualification: Compulsory			



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



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



Course L0141: Thermal Separation	Processes		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry's Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie 		



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



Module M0892: Chemical R	eaction Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fundamentals) (L0204)		Lecture	2	2
Chemical Reaction Engineering (Fundame	ntals) (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, physic	cal chemistry, technical thermodynamics I+II as w	rell as computational r	methods for engineers.
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemic	cal reaction engineering. They are able to point	out differences betwe	en thermodynamical and
	kinetical processes. The students have a strong ability to c	putline parts of isothermal and non-isothermal id	eal reactors and to de	scribe their properties.
Skills	After successful completion of the module, students are ab	ole to:		
	- apply different computational methods to dimension isoth	nermal and non-isothermal ideal reactors,		
	- determine and compute stable operation points for these	reactors,		
	- conduct experiments on a lab-scale pilot plants and docu	ument these according to scientific guidelines.		
Personal Competence				
Social Competence	After successful completition of the lab-course the stude	nts have a strong ability to organize themselfe	s in small groups to	solve issues in chemical
	reaction engineering. The students can discuss their subje	ect related knowledge among each other and wi	th their teachers.	
Autonomy	The students are able to obtain further information and a	assess their relevance autonomously. Students	can apply their know	rldege 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): Special	isation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Special			
	General Engineering Science (German program, 7 semes	ter): Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semes	, .	•	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Speciali	sation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Speciali	sation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semest	ter): Specialisation Process Engineering: Compu	ılsory	
	General Engineering Science (English program, 7 semest	ter): Specialisation Bioprocess Engineering: Cor	npulsory	
	Process Engineering: Core qualification: Compulsory			

Course L0204: Chemical Reaction Engineering (Fundamentals)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn	
Language	DE	
Cycle	WiSe	
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation	
	between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions) Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)	
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)	
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors,	



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

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

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

Literature

lecture notes Raimund Horn

skript Frerich Keil

Books:

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- $\hbox{H.\,S.\,Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall}\\$
- 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

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	ngineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE WiSe
Content	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, moles, mole fraction, volume, density, moler concentration, mass, moles, mole fraction, volume, density, moler concentration, mass, moles, mole fraction, volume, density, moler concentration, mass, moles, molecular concentration, mass, molecular concen
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relative between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, 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, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reactions, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanismicrokinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and p exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integrethed of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate in the properties of the proper
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactor single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stag reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic 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
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010



Course L0221: Experimental Course	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)



Module M1275: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (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 following l	learning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound k	knowledge 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 mitigation measures for environmental problems. They are able to determine geochemical			
Skills	parameters and to assess the potential of pollutants to migrate			
	Environmental Technology contributes to sustainable development			·
	Environmental recimiology contributes to sustainable development	t, and they can present and determ th	osc opinions in noncora	na agamet the group.
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different			
	approaches to the task as a group as well as to discuss their theore	etical 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	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	rocess Engineering: Elective Compul	sory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviromental I	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	•		
	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	sialisation Bioprocess Engineering: El	lective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory			

Course L1387: Practical Exercise E	invironmental 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 Tech	nologie
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)



Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Control Systems (L1119)		Laboratory Course	2	2
Measurement Technology for Mechanical and Process Engineers (L1116)		Lecture	2	3
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1
Module Responsible	Dr. Sven Krause			
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineeri	ng		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundmentals of	the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static a
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for di	forest kinds of quantities to be massured	Electrical Quantities	Comporaturo mochani
	quantities, Flow, Time, Frequency).	lerent kinds of quantities to be maesured (Liectrical Quartities,	remperature, mechani
	qualitues, flow, fille, frequency).			
	They can describe important methods of chemical Analysis (Ga	s Sensors, Spectroscopy, Gas Chromatogo	raphy)	
Skills	Students can select suitable measuring methods to given probl	ems and can use refering measurement de	evices in practice.	
	The students are able to orally explain issues in the subject ar	ea of measurement technology and solution	on approaches as wel	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	m in a common report.		
Autonomy	Students are able to familiarize themselves with new measurer	nent technologies.		
		-		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation		Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	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):			
	General Engineering Science (German program, 7 semester):		uisory	
	Energy and Environmental Engineering: Core qualification: Co	,	ompulaan.	
	General Engineering Science (English program): Specialisation	•	ompulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S		aineering: Compulsor	v
	General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S			у
	General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S		. ,	
	General Engineering Science (English program, 7 semester): S			
	Mechanical Engineering: Core qualification: Compulsory	pooransauon i 100ess Engineening. Compi	21001 y	
	Mechatronics: Core qualification: Compulsory			



Тур	Laboratory Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Wolfgang Schröder
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutar
	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 Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and fiber optic:
	interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaf
	Verlagsgesellschaft, Stuttgart, 1974
	 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, Mün
	Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung
	Gebrauchs- und Bedienungsanweisungen
	VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1
	Versuch 2:
	Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren
	Simulationsmethoden, speziell: Verwendung von Blockschaltbildern
	Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze
	Versuch 3:
	Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984
	Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988
	Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989
	Versuch 4:
	Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden
	Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen
	can Earles systems to season distinuity of the Entwart emberringer riegoranger



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 Mrs.
Cycle	WiSe 1 Fundamentals
Comon	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



Madula MOCCO D	d Dlant Engine sping I					
Module M0539: Process an	a Plant Engineering I					
Courses						
Title		Тур	Hrs/wk	CP		
Process and Plant Engineering I (L0095)		Lecture	2	2		
Process and Plant Engineering I (L0096)		Recitation Section (large)	1	2		
Process and Plant Engineering I (L1214)		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 le	arning results				
Professional Competence	atudanta con:					
Knowledge	students can:					
	classify and formulate blobal balance equations of chemical process	es				
	specify linear component equations of complex chemical processes					
	explain linear regression and data reconcilliation problems					
	explain pfd-diagrams					
Skills	students are capable of					
	- formulation of mass and energy balance equations and estimation	of product streams				
	- estimation of component streams of chemical plants using linear co	stimation of component streams of chemical plants using linear component balance models				
	olution of data reconcilliation tasks					
	conduction of process synthesis					
	economic evaluation of processes and the estimation of production costs					
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Examination	Written exam					
Examination duration and scale	120 Min. lectures notes and books					
Assignment for the Following	General Engineering Science (German program): Specialisation Pro	cess Engineering: Compulsory				
Curricula	General Engineering Science (German program): Specialisation Bio	process Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specia	alisation Process Engineering: Compu	Isory			
	General Engineering Science (German program, 7 semester): Specia					
	General Engineering Science (German program, 7 semester): Specia	alisation Energy and Enviromental Eng	ineering: Elective Co	mpulsory		
	Bioprocess Engineering: Core qualification: Compulsory					
	General Engineering Science (English program): Specialisation Biop					
	General Engineering Science (English program): Specialisation Prod					
	General Engineering Science (English program, 7 semester): Specia					
	General Engineering Science (English program, 7 semester): Specia					
	General Engineering Science (English program, 7 semester): Specia	alisation Energy and Enviromental Eng	ineering: Elective Co	npulsory		
	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	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

G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19

G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306

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

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

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

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

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

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

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

J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002

J. Krekel, G. Siekmann, 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	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				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	 name and explain processes and unit-operations of solids; 	process engineering.		
	characterize particles, particle distributions and to discuss the characterize particles.			
Skills	Students are able to			
	 choose and design apparatuses and processes for solids processes 	range in a good with a to the desired sell	do proportino of the pro	duat
	asses solids with respect to their behavior in solids processis.		as properties of the pro	duci
	document their work scientifically.	ng steps		
	document their work scientifically.			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with other st	udents or scientific personal and to de	velop solutions for tecl	nnical-scientific issues in
	a group.			
Autonomy	Students are able to analyze and solve questions regarding solid p	articles independently.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Pr	ocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bi	oprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Er	nergy and Enviromental Engineering: 0	Compulsory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviromental E	ngineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compu	•		
	General Engineering Science (English program): Specialisation Bio		La constantina	
	General Engineering Science (English program): Specialisation En	**	ompulsory	
	General Engineering Science (English program): Specialisation Pro		Joon	
	General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec		•	
	General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec	, , ,		,
	Process Engineering: Core qualification: Compulsory	ansation Ellergy and Elivironielital El	gineening. Compuisor)	,
	1 100633 Engineering. Oure quantication. 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	 Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

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

Course L0440: Particle Technology	
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	 Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



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 mode of matricinates and accompany
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 sub-disciplines in Management and to name important definitions from the sub-disciplines in Management and the sub-di
	field of Management
	explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects
	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
	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 management goals and structures of companies analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
oodal oompetende	Siduento 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.
	to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following	
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 Givin- and Environmental Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	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 Consol Engineering Science (Cormon program, 7 competer), Specialization Machanical Engineering, E
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineerin



Compulsory

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

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



Thesis

Module M-001: Bachelor Th	nesis		
Courses			
Title	Typ Hrs/wk CP		
Module Responsible	Professoren der TUHH		
Admission Requirements	FTOIGSSOIGH GETTOTHT		
Admission Requirements	According to General Regulations §24 (1):		
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.		
Recommended Previous			
Knowledge Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence	This taking part succession, succession ratio reaction are instruming reacting reacting.		
Knowledge			
	The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study	y (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 at a capable in the students are capable in relation to a specific issue of opening up at a capable in the students.		
	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 issu	es, and	
	develop solutions.		
	The students can take up a critical position on the findings of their own research work from a specialized perspective.		
Personal Competence			
Social Competence	Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured visiting and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured visiting and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured visiting and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured visiting accurate to the scientific issue for an expert audience accurately.	way.	
	The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing		
	can uphold their own assessments and viewpoints convincingly.		
Autonomy	The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time fran	ne.	
	The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.		
	The students can apply the essential techniques of scientific work to research of their own.		
Wester d'e Herre	Indicated at A. J. Tray 200 Ord. Tray indicate at 2		
Workload in Hours Credit points	Independent Study Time 360, Study Time in Lecture 0		
Examination	according to Subject Specific Regulations		
Examination duration and scale			
Assignment for the Following			
Curricula			
	Civil- and Environmental Engineering: Thesis: Compulsory		
	Bioprocess Engineering: Thesis: Compulsory		
	Computer Science: Thesis: Compulsory		
	Electrical Engineering: Thesis: Compulsory		
	Energy and Environmental Engineering: Thesis: Compulsory		
	General Engineering Science (English program): Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory		
	Computational Science and Engineering: Thesis: Compulsory		
	Logistics and Mobility: Thesis: Compulsory		
	Mechanical Engineering: Thesis: Compulsory		
	Mechatronics: Thesis: Compulsory		
	Naval Architecture: Thesis: Compulsory		
	Technomathematics: Thesis: Compulsory		
	xx: Thesis: Compulsory		
	Process Engineering: Thesis: Compulsory		