

Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2021 Updated: 24th May 2022

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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 (civil engineering, biotechnology, electrical engineering, energy- and environmental engineering, computer science, mechanical engineering, medical engineering, naval engineering, process engineering), some of them with further specialisations. GES has with 210 credit points a higher workload compared to other Bachelor study courses. Therefore General Engineering Science is designed for 7 semesters.

Career prospects

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

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

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

Learning target

Knowledge

Students can:

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

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

Skills

Graduates are able to

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

Social Competence

Graduates are able to

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

Autonomy

Graduates are able to

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

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

Program structure

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

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

Core Qualification

Module Responsible	Dagmar Richter
•	None
Recommended Previous	None
Knowledge	1
-	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The Non-technical Academic Programms (NTA)
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fu Self-reliance, self-management, collaboration and professional and personnel management competences. The departm implements these training objectives in its teaching architecture , in its teaching and learning arrangements , in teach areas and by means of teaching offerings in which students can qualify by opting for specific competences and a compete level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechn complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechn academic programms follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development competences. It also provides orientation knowledge in the form of "profiles"
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation study these subjects in one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dea with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberat encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migral studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semes 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a groriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging go oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. Th differences are reflected in the practical examples used, in content topics that refer to different professional application conte and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leaders functions of Bachelor's and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	 locate selected specialized areas with the relevant non-technical mother discipline, outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in learning area, different specialist disciplines relate to their own discipline and differentiate it as well as make connections, sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of represental in the specialized sciences are subject to individual and socio-cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
JKIII3	
	In selected sub-areas students can
	 apply basic methods of the said scientific disciplines, auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned special discipline,
	 to handle simple questions in aforementioned scientific disciplines in a sucsessful manner, justify their decisions on forms of organization and application in practical questions in contexts that go beyond technical relationship to the subject.

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

Courses

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

Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields						
Courses						
Title				Тур	Hrs/wk	СР
Electrical Engineering I: Direct Curr				Lecture	3	5
Electrical Engineering I: Direct Curr	rent Networks and Elect	romagnetic Fields (L	0676)	Recitation Section (small)	2	1
Module Responsible	Prof. Matthias Kuhl					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part suc	cessfully, students	have reached the follow	ing learning results		
Professional Competence						
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study T	ïme 110, Study Tir	me in Lecture 70			
Credit points	6					
Course achievement		Form	Description			
	No 10 %	Excercises				
Examination	Written exam					
Examination duration and	120 Minutes					
scale						
Assignment for the			-	ore Qualification: Compulsory		
Following Curricula			Engineering: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory					
		5	g: Core Qualification: Cor	npulsory		
	Mechatronics: Core Qualification: Compulsory					
	Orientation Studies:	Core Qualification:	Elective Compulsory			

Course L0675: Electrical Engineering 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	of. Matthias Kuhl	
Language	E	
Cycle	WiSe	
Content		
Literature	 M. Kasper, Skript zur Vorlesung Elektrotechnik 1, 2013 M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004 F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005 A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008 	

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

Courses				
Title		Тур	Hrs/wk	СР
Mechanics I (Statics) (L1001)		Lecture	2	3
Mechanics I (Statics) (L1002)		Recitation Section (small)	2	2
Mechanics I (Statics) (L1003)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe the axiomatic procedure used in mec 	hanical contoxts:		
	 explain important steps in model design; 	nanca contexts,		
	 present technical knowledge in stereostatics. 			
	present commentation age in stereostatios			
Skills	The students can			
	explain the important elements of mathematic	cal / mechanical analysis and model for	mation, and appl	v it to the context
	their own problems;			,
	 apply basic statical methods to engineering pr 	oblems;		
	 estimate the reach and boundaries of statical i 		ole to wider probl	lem sets.
Personal Competence				
Social Competence	The students can work in groups and support each ot	her to overcome difficulties.		
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Core Qualificat	ion: Compulsory		
	Bioprocess Engineering: Core Qualification: Compulse	bry		
	Data Science: Specialisation Mechanics: Compulsory			
	Digital Mechanical Engineering: Core Qualification: Co	ompulsory		
	Electrical Engineering: Core Qualification: Elective Co	mpulsory		
	Green Technologies: Energy, Water, Climate: Core Qu	ualification: Compulsory		
	Computational Science and Engineering: Specialisation	on II. Mathematics & Engineering Science	e: Elective Compu	ulsory
	Logistics and Mobility: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulse	ory		
	Mechatronics: Core Qualification: Compulsory			
	Orientation Studies: Core Qualification: Elective Comp	oulsory		
	Orientation Studies: Core Qualification: Elective Com Naval Architecture: Core Qualification: Compulsory	pulsory		
	Orientation Studies: Core Qualification: Elective Comp	oulsory		

Course L1001: Mechanics I (S	Statics)
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	 Tasks in Mechanics Modelling and model elements Vector calculus for forces and torques Forces and equilibrium in space Constraints and reactions, characterization of constraint systems Planar and spatial truss structures Internal forces and moments for beams and frames Center of mass, volumn, area and line Computation of center of mass by intergals, joint bodies Friction (sliding and sticking) Friction of ropes
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

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

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

Module M0850: Mathe	ematics I					
Courses						
Title		Тур	Hrs/wk	СР		
Analysis I (L1010)		Lecture	2	2		
		Recitation Section (small)	1	1		
Analysis I (L1012)			1	1		
Analysis I (L1013)		Recitation Section (large)	2			
Linear Algebra I (L0912)		Lecture		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	e reached the following learning results				
Professional Competence						
Knowledge						
Kilomeuge	 Students can name the basic conce 	pts in analysis and linear algebra. They are at	ole to explain the	em using appropria		
	examples.					
	 Students can discuss logical connect 	ions between these concepts. They are capable	of illustrating th	ese connections w		
	the help of examples.		5			
	 They know proof strategies and can r 	correduce them				
		epioduce mem.				
Skills	Ctudents can madel problems in ana	lycic and linear algebra with the help of the con-	onto studiod in t	his course Moreov		
		lysis and linear algebra with the help of the cond	epts studied in t	This course. Moreov		
	they are capable of solving them by a					
	 Students are able to discover and ver 	ify further logical connections between the conce	epts studied in the	e course.		
	 For a given problem, the students of 	an develop and execute a suitable approach, a	and are able to c	critically evaluate t		
	results.					
Deveral Competence						
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 ca 					
			peracing partners	s. Moreover, they c		
	design examples to check and deepe	n the understanding of their peers.				
Autonomy						
, laterionity	 Students are capable of checking the 	eir understanding of complex concepts on their	own. They can sp	pecify open question		
	precisely and know where to get help	in solving them.				
	• Students have developed sufficient	persistence to be able to work for longer period	ds in a goal-orier	nted manner on ha		
	problems.		5			
	problemor					
	Independent Study Time 128, Study Time in	Lecture 112				
Credit points	8					
Course achievement	None					
Examination	Written exam					
Examination duration and	60 min (Analysis I) + 60 min (Linear Algebra	a I)				
scale						
	Gonoral Engineering Science (German prog	ram 7 somestor): Core Qualification: Compulson				
-		ram, 7 semester): Core Qualification: Compulsory				
Following Curricula	Civil- and Environmental Engineering: Core					
	Bioprocess Engineering: Core Qualification:					
	Digital Mechanical Engineering: Core Qualifi	cation: Compulsory				
	Electrical Engineering: Core Qualification: Co	ompulsory				
	Green Technologies: Energy, Water, Climate	e: Core Qualification: Compulsory				
	Computational Science and Engineering: Co					
	Logistics and Mobility: Core Qualification: Co					
	Mechanical Engineering: Core Qualification:					
	Mechatronics: Core Qualification: Compulsor	-				
	Orientation Studies: Core Qualification: Elec	tive Compulsory				
	Naval Architecture: Core Qualification: Com	pulsory				
	Process Engineering: Core Qualification: Cor	npulsory				
		jistics and Mobility: Core Qualification: Compulso	~			
	and handgement major in E0g	,	,			

Course L1010: Analysis I				
Тур	Lecture			
Hrs/wk				
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dozenten des Fachbereiches Mathematik der UHH			
Language	DE			
Cycle	WiSe			
Content	Foundations of differential and integrational calculus of one variable			
	 statements, sets and functions natural and real numbers convergence of sequences and series continuous and differentiable functions mean value theorems Taylor series calculus error analysis fixpoint iteration 			
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 			

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

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

Course L0912: Linear Algebra	al
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Dennis Clemens
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes systems of linear equations: Gauß elimination, matrix product, inverse matrices, transformations, block matrices, determinants orthogonal projection in R^n, Gram-Schmidt-Orthonormalization
Literature	 T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 G. Strang: Lineare Algebra, Springer-Verlag, 2003 G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013

Course L0913: Linear Algebra	al				
Тур	ecitation 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, Dr. Dennis Clemens				
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	rse L0914: Linear Algebra I				
Тур	citation Section (large)				
Hrs/wk	1				
CP	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Dr. Christian Seifert, Dr. Dennis Clemens				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0687: Chem	istry				
Houdie Houor. Chem	istry				
Courses					
Title		Тур	Hrs/wk	СР	
Chemistry I+II (L0460)		Lecture	4	4	
Chemistry I+II (L0475)		Recitation Section (large)	2	2	
Module Responsible	Dr. Dorothea Rechtenbach				
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 are able to name and to describe ba table, chemical bonds), physical chemistry (a chemistry (acid/base, pH-value, salts, solubility, n carbonyl compounds, aromates, reaction mecha explain basic chemical terms.	ggregate states, separating processes, t redox, metals) and organic chemistry (aliph	hermodynamics, atic hydrocarbon	kinetics), inorga s, functional grou	
Skills	After successful completion of this module students are able to describe substance groups and chemical compounds. On this bas they are capable of explaining, choosing and applying specific methods and various reaction mechanisms.				
Personal Competence					
Social Competence	Students are able to take part in discussions on c contribute to those discussion by their own stater	•	of an interdiscipli	nary team. They o	
Autonomy	After successful completion of this module students are able to solve chemical problems independently by defending propose approaches with arguments. They can also document their approaches.				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program, 7	semester): Core Qualification: Compulsory			
Following Curricula					
		g Science: Elective Compulsory			

Course L04	60: Chemistry I+II				
Тур	Lecture				
Hrs/wk	4				
СР	4				
Workload	Independent Study Time 64, Study Time in Lecture 56				
in Hours Lecturer	Dr. Christoph Wutz				
	DE				
Cycle					
	Chemistry I:				
	- Structure of matter				
	- Periodic table				
	- Electronegativity				
	- Chemical bonds				
	- Solid compounds and solutions				
	- Chemistry of water				
	- Chemical reactions and equilibria				
	- Acid-base reactions				
	- Redox reactions				
	Chemistry II:				
	- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,				
	- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars				
	- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction				
	- Practical applications and examples				
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure				
	- Kickelbick: Chemie für Ingenieure (Pearson)				
	- Mortimer: Chemie. Basiswissen der Chemie.				
	- Brown, LeMay, Bursten: Chemie. Studieren kompakt.				
	- Schmuck: Basisbuch Organische Chemie (Pearson)				

Course L0475: Chemistry I+I	ourse L0475: Chemistry I+II				
Тур	Recitation Section (large)				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Dr. Dorothea Rechtenbach				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Courses							
Title				Тур	Hrs/wk	СР	
Computer Science for Engineers - I					Lecture	3	3
Computer Science for Engineers - Introduction and Overview (L2686)				Recitation Section (small)	2	3	
Module Responsible		nwin Fey					
Admission Requirements	None						
Recommended Previous							
Knowledge			f. II		in a la suela sues des		
Educational Objectives	After taking	g part suc	cessfully, students n	ave reached the follow	ing learning results		
Professional Competence Knowledge							
Skills							
Personal Competence							
Social Competence							
Autonomy							
Workload in Hours	Independe	nt Study T	ime 110. Study Time	e in Lecture 70			
Credit points							
Course achievement	Compulsory	Bonus	Form	Description			
	No	10 %	Attestation	Testate finde	en semesterbegleitend statt.		
Examination	Written exa	am					
Examination duration and	90 min						
scale							
Assignment for the	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory						
Following Curricula		-					
	Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory						
	Logistics and Mobility: Core Qualification: Compulsory						
	Mechanical Engineering: Core Qualification: Compulsory						
	Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory						
		Naval Architecture: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory					

Course L2685: Computer Science for Engineers - Introduction and Overview				
Тур	Lecture			
Hrs/wk	3			
CP	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Görschwin Fey			
Language	DE/EN			
Cycle	WiSe			
Content				
Literature	 Informatik Helmut Herold, Bruno Lurz, Jürgen Wohlrab, Matthias Hopf: Grundlagen der Informatik, 3. Auflage, 816 Seiten, Pearson Studium, 2017. C++ Bjarne Stroustrup, Einführung in die Programmierung mit C++, 479 Seiten, Pearson Studium, 2010. > in der englischen Version bereits eine neuere Auflage! Jürgen Wolf : Grundkurs C++: C++-Programmierung verständlich erklärt, Rheinwerk Computing, 3. Auflage, 2016. 			

ourse L2686: Computer Science for Engineers - Introduction and Overview		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Görschwin Fey	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
		-	Here foods	CD
Title Electrical Engineering II: Alternatin	g Current Networks and Basic Devices (L0178)	Typ Lecture	Hrs/wk 3	CP 5
	g Current Networks and Basic Devices (L0178) g Current Networks and Basic Devices (L0179)	Recitation Section (small)	2	1
Module Responsible				
Admission Requirements				
Recommended Previous				
Knowledge				
lineineuge	Mathematics I			
	Direct current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence	After taking part successiony, students have reached t			
	Students are able to reproduce and explain fundame	ental theories principles and methods	related to the t	heory of alternat
Knowledge	currents. They can describe networks of linear elemen			
	an overview of applications for the theory of alternat			
	explaining the behavior of fundamental passive and ac			
Skills	Students are capable of calculating parameters within	n simple electrical networks at alternat	ting currents by	means of a comp
	notation for voltages and currents. They can apprai			
	alternating currents. Students are able to analyze simple circuits such as oscillating circuits, filter, and matching network			
	quantitatively and dimension elements by means of a design. They can motivate and justify the fundamental elements of a			
	electrical power supply (transformer, transmission line, compensation of reactive power, multiphase system) and are qualified t			
	dimension their main features.			
Personal Competence				
Social Competence	Students are able to work together on subject related t	tasks in small groups. They are able to	present their resu	ults effectively.
Autonomy	Students are capable to gather necessary information	n from the references provided and rela	ate that informat	ion to the context
	the lecture. They are able to continually reflect their ki	nowledge by means of activities that ac	company the lec	ture, such as onli
	tests and exercises that are related to the exam. Bas			
	learning process. They are able to draw connections		this lecture and	the content of ot
	lectures (e.g. Electrical Engineering I, Linear Algebra, a	and Analysis).		
		<u></u>		
	Independent Study Time 110, Study Time in Lecture 70	v		
Credit points		cription		
Course achievement	No 10 % Midterm			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	nester): Core Qualification: Compulsory		
Following Curricula	Data Science: Specialisation Electrical Engineering: Co	mpulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	Computational Science and Engineering: Core Qualifica	ation: Compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Orientation Studies: Core Qualification: Elective Compu	ulsory		

Course L0178: Electrical Eng	ineering II: Alternating Current Networks and Basic Devices
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
Content	- General time-dependency of electrical networks
	- Representation and properties of harmonic signals
	- RLC-elements at alternating currents/voltages
	- Complex notation for the representation of RLC-elements
	- Power in electrical networks at alternating currents, compensation of reactive power
	- Frequency response locus (Nyquist plot) and Bode-diagrams
	- Measurement instrumentation for assessing alternating currents
	- Oscillating circuits, filters, electrical transmission lines
	- Transformers, three-phase current, energy converters
	- Simple non-linear and active electrical devices
Literature	- M. Albach, "Elektrotechnik", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
	- R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010)
	- C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009)
	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013)
	- R. Dorf, "The Electrical Engineering Handbook", CRC (2006)

Course L0179: Electrical Eng	ineering 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	Se			
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)			

Typ Lecture Recitation Section (large) rring g learning results elements, arios and practical examples elements, tents and tasks (problem solv tasketches,		CP 3 3
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arios and practical examples elements, nents and tasks (problem solv		ne elements, indicato
nents and tasks (problem solv	lving skills),	
ecture supported by activatin	ng methods.	
knowledge in exercises. o recapitulate poorly unders	stood content e.c	g. by using the vide
e Qualification: Compulsory		
ју Technology: Elective Com	npulsory	
rg		ore Qualification: Compulsory rgy Technology: Elective Compulsory ctive Compulsory

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

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

Courses				
Title		Тур	Hrs/wk	СР
Mechanics II (L0493)		Lecture	2	2
Mechanics II (L0494)		Recitation Section (small)	2	2
Mechanics II (L1691)		Recitation Section (large)	2	2
Module Responsible	Prof. Christian Cyron			
Admission Requirements	None			
Recommended Previous	Mechanics I			
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Having accomplished this module, the s	tudents know and understand the basic co	oncepts of continu	ium mechanics ai
	elastostatics, in particular stress, strain, o	onstitutive laws, stretching, bending, torsion	failure analysis, e	energy methods ar
	stability of structures.			
Skills	Having accomplished this module, the stude	nts are able to		
	- apply the fundamental concepts of mathematical and mechanical modeling and analysis to problems of their choice			
- apply the basic methods of elastostatics to problems of engineering, in particular in the design of mechanical				l structures
	- to educate themselves about more advance	ed aspects of elastostatics		
Personal Competence				
Social Competence	-			
Autonomy	-			
,	Independent Study Time 96, Study Time in	lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German prog	am, 7 semester): Core Qualification: Compulso	ry	
Following Curricula	Civil- and Environmental Engineering: Core	Qualification: Compulsory		
	Bioprocess Engineering: Core Qualification:	Compulsory		
	Data Science: Specialisation Mechanics: Cor	npulsory		
	Digital Mechanical Engineering: Core Qualifi	cation: Compulsory		
	Electrical Engineering: Core Qualification: El	ective Compulsory		
	Green Technologies: Energy, Water, Climate	: Core Qualification: Compulsory		
	Logistics and Mobility: Core Qualification: Co	mpulsory		
	Mechanical Engineering: Core Qualification:	Compulsory		
	Mechatronics: Core Qualification: Compulso	У		
	Orientation Studies: Core Qualification: Elec	tive Compulsory		
	Naval Architecture: Core Qualification: Com	pulsory		
	Technomathematics: Specialisation III. Engin	neering Science: Elective Compulsory		
	Process Engineering: Core Qualification: Cor			

Course L0493: Mechanics II	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	stresses and strains
	Hooke's law
	tension and compression
	torsion
	bending
	stability
	buckling
	energy methods
Literature	 Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer

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

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

Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics I (L043		Lecture	2	4
Technical Thermodynamics I (L043		Recitation Section (large)	1	1
Technical Thermodynamics I (L044		Recitation Section (small)	1	1
	Prof. Dr. Arne Speerforck			
Admission Requirements				
	Elementary knowledge in Mathematics and Mechan	ics		
Knowledge				
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodyna	amics. They know the relation of the kind	ls of energy acc	ording to 1 st law
	distinguish between state variables and process variables and know the meaning of different state variables like temp enthalpy, entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermod related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equ state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamics.			n a Thermodynam related equations
Skills	Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and her simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an idea for a real gas from measured thermal state variables.			
Personal Competence Social Competence	The students are able to discuss in small groups an	d develop an approach.		
Autonomy	Students are able to define independently tasks, to knowledge in practice.	get new knowledge from existing knowledge	dge as well as to	o find ways to use t
Workload in Hours	Independent Study Time 124, Study Time in Lecture	= 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 s	emester): Core Qualification: Compulsory		
Following Curricula	Bioprocess Engineering: Core Qualification: Comput	sory		
	Digital Mechanical Engineering: Core Qualification:	Compulsory		
	Green Technologies: Energy, Water, Climate: Core (Qualification: Compulsory		
	Logistics and Mobility: Specialisation Traffic Plannin	g and Systems: Elective Compulsory		
	Mechanical Engineering: Core Qualification: Compu	sory		
	Mechatronics: Core Qualification: Compulsory			
	Orientation Studies: Core Qualification: Elective Cor	npulsory		
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		
	Process Engineering: Core Qualification: Compulsor	ý		
	Engineering and Management - Major in Logistics a			

Тур	Lecture		
Hrs/wk	2		
CP	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Dr. Arne Speerforck		
Language	DE		
Cycle	SoSe		
Content			
	1. Introduction		
	2. Fundamental terms		
	3. Thermal Equilibrium and temperature		
	3.1 Thermal equation of state		
	4. First law		
	4.1 Heat and work		
	4.2 First law for closed systems		
	4.3 First law for open systems		
	4.4 Examples		
	5. Equations of state and changes of state		
	5.1 Changes of state		
	5.2 Cycle processes		
	6. Second law		
	6.1 Carnot process		
	6.2 Entropy		
	6.3 Examples		
	6.4 Exergy		
	7. Thermodynamic properties of pure fluids		
	7.1 Fundamental equations of Thermodynamics		
	7.2 Thermodynamic potentials		
	7.3 Calorific state variables for arbritary fluids		
	7.4 state equations (van der Waals u.a.)		
Literature			
Literature	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009		
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012		
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993		

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

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

Module M0851: Mathe	ematics II			
Courses				
Title		Typ	Hrs/wk	СР
		Тур		
Analysis II (L1025)		Lecture	2	2
Analysis II (L1026)		Recitation Section (large)	1	1
Analysis II (L1027)		Recitation Section (small)	1	1
Linear Algebra II (L0915)		Lecture	2	2
Linear Algebra II (L0916)		Recitation Section (small)	1	1
Linear Algebra II (L0917)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
	None			
	Mathematics I			
Knowledge				
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	· Chudente con nonce further conce	ante in analysis and linear sleakers. They are shi	a ta avalain tha	
		epts in analysis and linear algebra. They are abl	e to explain the	em using appropria
	examples.			
	 Students can discuss logical conner 	ections between these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and car 	n reproduce them.		
Skills				
54113	 Students can model problems in an 	nalysis and linear algebra with the help of the conc	epts studied in tl	his course. Moreov
	they are capable of solving them b	v applying established methods.		
		verify further logical connections between the conce	onte studiod in the	
		s can develop and execute a suitable approach, a	ind are able to c	fillcally evaluate i
	results.			
Personal Competence				
Social Competence				
Social Competence	 Students are able to work together 	in teams. They are capable to use mathematics as	a common langu	age.
	 In doing so, they can communicate 	e new concepts according to the needs of their coo	perating partners	. Moreover, they c
		pen the understanding of their peers.	51.	, . , . , .
	design examples to check and dee	per the understanding of their peers.		
Autonomy	· Students are capable of checking	their understanding of complex concents on their (we They can ce	ocify open questio
		their understanding of complex concepts on their of	own. They can sp	ecity open questic
	precisely and know where to get he	elp in solving them.		
	 Students have developed sufficient 	t persistence to be able to work for longer period	ls in a goal-orien	ted manner on ha
	problems.			
Workload in Hours	Independent Study Time 128, Study Time	in Lecture 112		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Analysis II) + 60 min (Linear Alge	bra II)		
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Cor	e Qualification: Compulsory		
3 • • • • • • • •	Bioprocess Engineering: Core Qualification			
	, , , , , , , , , , , , , , , , , , , ,			
	Digital Mechanical Engineering: Core Qua			
	Electrical Engineering: Core Qualification:			
	Green Technologies: Energy, Water, Clima	ate: Core Qualification: Compulsory		
	Computational Science and Engineering:	Core Qualification: Compulsory		
	Logistics and Mobility: Core Qualification:	Compulsory		
	Mechanical Engineering: Core Qualificatio	n: Compulsory		
	Mechatronics: Core Qualification: Compute			
	Orientation Studies: Core Qualification: El			
	Naval Architecture: Core Qualification: Co	mpulsony		
	Process Engineering: Core Qualification: Co			

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

Course L1026: Analysis II	irse 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, Dr. Sebastian Götschel		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1027: Analysis II	urse 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	a II		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Dennis Clemens		
Language	DE		
Cycle	SoSe		
Content	 general vector spaces: subspaces, Euclidean vector spaces linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices system of linear differential equations matrix factorizations: LR-decomposition, QR-decomposition, Schur decomposition, Jordan normal form, singular value decomposition 		
Literature	 T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 G. Strang: Lineare Algebra, Springer-Verlag, 2003 G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013 		

Course L0916: Linear Algebra	a II		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Dennis Clemens		
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	urse L0917: Linear Algebra II		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert, Dr. Dennis Clemens		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0688: Techr	nical Thermodynamics II			
Courses				
Fitle		Тур	Hrs/wk	СР
Technical Thermodynamics II (L044	19)	Lecture	2	4
Technical Thermodynamics II (L045		Recitation Section (larg		1
Technical Thermodynamics II (L045		Recitation Section (sma	ll) 1	1
	Prof. Dr. Arne Speerforck			
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics, Me	chanics and Technical Thermodynamics I		
Knowledge	After taking part average fully students have	a reached the following learning results		
	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge		rocesses like Joule, Otto, Diesel, Stirling, Sei	-	-
		es and know the influence different factor		
		er cycle, cooling cycle). They have increased		
		mics related diagrams. They know the law		
		combustion calculations. They are provided	with basic knowledg	e in gas dynamics a
	know the definition of the speed of sound a	and know about a Laval nozzle.		
Skills	Students are able to use thermodynamic I	aws for the design of technical processes. E	specially they are ab	e to formulate ener
	exergy- and entropy balances and by this	to optimise technical processes. They are a	ble to perform simple	e safety calculation
	regard to an outflowing gas from a tank	c. They are able to transform a verbal for	mulated message ir	to an abstract for
	procedure.			
Demonstration of the second				
Personal Competence				
Social Competence		groups and develop an approach. You can a		
	content that are provided in the lecture will	th the ClickerOnline tool "TurningPoint" after	discussions with othe	er students.
Autonomy	Students can physically understand and e	explain the complex problems (cycle proces	ses, air conditioning	processes, combust
		select the methods taught in the lecture ar		
	apply them independently to different type			
Workload in Hours	Independent Study Time 124, Study Time	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Core Qualification: Comp	ulsory	
Following Curricula	Bioprocess Engineering: Core Qualification	Compulsory		
-	Chemical and Bioprocess Engineering: Cor	e Qualification: Compulsory		
		Course Core Studies: Elective Compulsory		
	Engineering Science: Specialisation Mecha			
		ram, 7 semester): Specialisation Mechanical	Engineerina: Elective	Compulsorv
	Green Technologies: Energy, Water, Climat		Licetive	
	Integrated Building Technology: Core Qual			
	Mechanical Engineering: Core Qualification			
	Mechatronics: Core Qualification: Compulsi			
		•		
	Technomathematics: Specialisation III. Eng			
	Process Engineering: Core Qualification: Co	nihaisol à		

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

Course L0450: Technical The	urse 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. Dr. Arne Speerforck	
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. Dr. Arne Speerforck
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0853: Math	ematics III			
Courses				
Title Analysis III (L1028) Analysis III (L1029) Analysis III (L1030) Differential Equations 1 (Ordinary I		Typ Lecture Recitation Section (small) Recitation Section (large) Lecture	Hrs/wk 2 1 1 2	CP 2 1 1 2
Differential Equations 1 (Ordinary E Differential Equations 1 (Ordinary E		Recitation Section (small) Recitation Section (large)	1 1	1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I + II			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge Skills	 Students can name the basic concepts in the area appropriate examples. Students can discuss logical connections betwee the help of examples. They know proof strategies and can reproduce the strategies and	en these concepts. They are capable		
SKIIIS	 Students can model problems in the area of anal course. Moreover, they are capable of solving the Students are able to discover and verify further lot For a given problem, the students can develop results. 	em by applying established methods. ogical connections between the conce	pts studied in the	e course.
Personal Competence Social Competence	 Students are able to work together in teams. The In doing so, they can communicate new concept: design examples to check and deepen the undersection. 	s according to the needs of their coop		
Autonomy	 Students are capable of checking their understal precisely and know where to get help in solving t Students have developed sufficient persistence problems. 	hem.		
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112	2		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Analysis III) + 60 min (Differential Equations 1)			
scale				
Assignment for the				
Following Curricula	Civil- and Environmental Engineering: Core Qualification Bioprocess Engineering: Core Qualification: Compulsory			
	Chemical and Bioprocess Engineering: Core Qualification			
	Digital Mechanical Engineering: Core Qualification: Com	pulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	Green Technologies: Energy, Water, Climate: Core Quali			
	Computer Science in Engineering: Core Qualification: Co			
	Integrated Building Technology: Core Qualification: Com Logistics and Mobility: Specialisation Traffic Planning an			
	Logistics and Mobility: Specialisation Production Manage		lsory	
	Logistics and Mobility: Specialisation Information Technol			
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory		and Systems: Ele	ective Compulsory
	Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory	lobility: Specialisation Traffic Planning		

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

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

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

Content

Literature

See interlocking course

See interlocking course

	eering Mechanics III (Dynam				
Courses					
Title		1	Гур	Hrs/wk	СР
Engineering Mechanics III (Dynami	cs) (L1134)		ecture	3	3
ngineering Mechanics III (Dynami	cs) (L1136)	F	Recitation Section (large)	1	1
Engineering Mechanics III (Dynami	cs) (L1135)	F	Recitation Section (small)	2	2
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics I, II, Engineering Mechanics I (Statics). Parallel to Engineering Mechanik III the module Mathematics III should attended.				
Educational Objectives	After taking part successfully, students ha	ave reached the following	learning results		
Professional Competence					
Knowledge	The students can				
	describe the axiomatic procedure u		xts;		
	explain important steps in model d	-			
	 present technical knowledge in kind 	ematics, kinetics and vib	rations.		
Skills	The students can				
	 explain the important elements of their own problems; apply basic kinematic, kinetic and estimate the reach and boundaries 	vibraton methods to engi	neering problems;		
	problem sets.				
Personal Competence					
Social Competence	The students can work in groups and supp	port each other to overco	me difficulties.		
Autonomy	Students are capable of determining their	r own strengths and weak	nesses and to organize th	eir time and learn	ing based on thos
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84			
Credit points					
Course achievement	None				
Examination					
Examination duration and					
scale					
	General Engineering Science (German pro	ogram 7 semester): Core	Qualification: Compulson	/	
Following Curricula		-	Qualification. compaisory	, ,	
ronowing curricula	Green Technologies: Energy, Water, Clima		v Technology: Elective Cor	mpulsory	
	Integrated Building Technology: Core Qua		Liective Col	iipaisoi y	
	Mechanical Engineering: Core Qualification				
	Mechatronics: Core Qualification: Compute				
	Naval Architecture: Core Qualification: Co		Compulso		
	Technomathematics: Specialisation III. En	gineering science: Electiv	ve compulsory		

Course L1134: Engineering M	fechanics III (Dynamics)
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	Kinematics
	1.1 Motion of a particle
	1.2 Planar motion of a rigid body
	1.3 Spatial motion of a rigid body
	1.4 Spatial relative Kinematics
	2 Kinetics
	2.1 Linear momentum and change of linear momentum
	2.2 Angular momentum and change of angular momentum
	2.3 Kinetics of rigid bodies
	2.4 Energy and balance of energy
	3 Vibrations
	3.1 Classification of Vibrations
	3.2 Free undamped vibration
	3.3 Free damped vibration
	3.4 Forced vibration
	4 Kinetics of gyroscopes
	4.1 Free gyroscopic motion
	4.2 Forced gyroscopic motion
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 L1136: Engineering N	ourse L1136: Engineering Mechanics III (Dynamics)	
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	

Course L1135: Engineering Mechanics III (Dynamics)	
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

Modulo M0672: Signa	le and Sustaine			
Module M0672: Signa	is and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	The modul is an introduction to the theory of signals a	nd systems. Cood knowledge in metho	an neuronal but the	, madula Mathamat
	1-3 is expected. Further experience with spectral tra	, ,	3	
	but not required.	isionnations (Fourier series, Fourier ti		transformy is usefu
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	s using methods o	of signal and systen
	theory. They are able to apply the fundamental trans	formations of continuous-time and dis	crete-time signals	and systems. The
	can describe and analyse deterministic signals and s	ystems mathematically in both time a	and image domain	n. In particular, the
	understand the effects in time domain and image d	omain which are caused by the trans	ition of a continu	ous-time signal to
	discrete-time signal.			
	The students are familiar with the contents of lecture	and tutorials. They can explain and app	oly them to new p	roblems.
Skills	The students are able to describe and analyse determ	inistic signals and linear time-invariant	: svstems using m	ethods of signal an
	system theory. They can analyse and design basic	-		-
	response, stability, linearity etc They can assess the			
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant informa	tion from appropriate literature sour	ces. They can c	ontrol their level o
	knowledge during the lecture period by solving tutoria	l problems, software tools, clicker syste	em.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Core Qualification: Compulsory		
Following Curricula	Computer Science: Core Qualification: Compulsory			
	Computer Science: Specialisation II. Mathematics and	Engineering Science: Elective Compuls	ory	
	Data Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	Computer Science in Engineering: Core Qualification:	Compulsory		
	Integrated Building Technology: Core Qualification: Co	mpulsory		
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Sc	ence: Elective Compulsory		

ourse L0432: Signals and S	ystems
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	SoSe
Content	Introduction to signal and system theory
	Introduction to signal and system theory
	• Signals
	Classification of signals
	 Continuous-time and discrete-time signals
	 Analog and digital signals
	 Deterministic and random signals
	 Description of LTI systems by differential equations or difference equations, respectively
	 Basic properties of signals and operations on signals
	Elementary signals
	 Distributions (Generalized Functions)
	• Power and energy of signals
	Correlation functions of deterministic signals
	Autocorrelation function
	Crosscorrelation function
	Orthogonal signals
	Applications of correlation Linear time-invariant (LTI) systems
	Linear time-invariant (LT) systems

- Linearity
- Time-invariance
- Description of LTI systems by impulse response and frequency response
- Convolution
- Convolution and correlation
- Properties of LTI-systems
- Causal systems
- Stable systems
- Memoryless systems
- Fourier Series and Fourier Transform
 - Fourier transform of continuous-time signals, discrete-time signals, periodic signals, non-periodic signals
 - Properties of the Fourier transform
 - Fourier transform of some basic signals
 - Parseval's theorem
- Analysis of LTI-systems and signals in the frequency domain
 - Frequency response, magnitude response and phase response
 - Transmission factor, attenuation, gain
 - Frequency-flat and frequency-selective LTI-systems
 - Bandwidth definitions
 - Basic types of systems (filters), lowpass, highpass, bandpass, bandstop systems
 - Phase delay and group delay
 - Linear-phase systems
 - Distortion-free systems
 - Spectrum analysis with limited observation window: Leakage effect
- Laplace Transform
 - Relation of Fourier transform and Laplace transform
 - Properties of the Laplace transform
 - Laplace transform of some basic signals
- Analysis of LTI-systems in the s-domain
 - Transfer function of LTI-systems
 - Relation of Laplace transform, magnitude response and phase response
 - Analysis of LTI-systems using pole-zero plots
 - Allpass filters
 - Minimum-phase, maximum-phase and mixed phase filters
 - Stable systems
- Sampling
 - Sampling theorem
 - Reconstruction of continuous-time signals in frequency domain and time domain
 - Oversampling
 - Aliasing
 - Sampling with pulses of finite duration, sample and hold
 - Decimation and interpolation
- Discrete-Time Fourier Transform (DTFT)
 - Relation of Fourier transform and DTFT
 - Properties of the DTFT
- Discrete Fourier Transform (DFT)
 - Relation of DTFT and DFT
 - Cyclic properties of the DFT
 - DFT matrix
 - Zero padding
 - Cyclic convolution
 - Fast Fourier Transform (FFT)
 - Application of the DFT: Orthogonal Frequency Division Multiplex (OFDM)
- Z-Transform
 - Relation of Laplace transform, DTFT, and z-transform
 - Properties of the z-transform
 - Z-transform of some basic discrete-time signals
- Discrete-time systems, digital filters
 - FIR and IIR filters
 - Z-transform of digital filters
 - Analysis of discrete-time systems using pole-zero plots in the z-domain
 - Stability
 - Allpass filters
 - Minimum-phase, maximum-phase and mixed-phase filters
 - Minimum-phase, maximum-phase and mixed-pi
 Linear phase filters
 - Enlear phase me
- Literature T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
 - K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
 - B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
 - J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
 - S. Haykin, B. van Veen: Signals and systems. Wiley.
 - Oppenheim, A.S. Willsky: Signals and Systems. Pearson.

• Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

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

Courses				
Title		Тур	Hrs/wk	СР
ntroduction to Control Systems (LC		Lecture	2	4
Introduction to Control Systems (LC		Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None Representation of signals and systems in time a	and frequency domain. Laplace transform		
Knowledge	Representation of signals and systems in time of	and nequency domain, Laplace transform		
j -				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	- Chudonka con ronzoont dunomio sustan	behavior in times and frequency density and	een in nerticular	
	 students can represent dynamic system first and second order systems 	behavior in time and frequency domain, and	can in particular	explain properties
		e control loops and interpret dynamic properti	es in terms of fre	quency response a
	root locus			
	They can explain the Nyquist stability cri	iterion and the stability margins derived from	it.	
	They can explain the role of the phase m	nargin in analysis and synthesis of control loop	IS	
		r affects a control loop in terms of its frequent		
	 They can explain issues arising when cor 	ntrollers designed in continuous time domain a	are implemented	digitally
Skills	- Chudonka con transforme modele of linear	dunamia austana franchina ta francusa au dan		
	 Students can transform models of linear They can simulate and assess the behav 	dynamic systems from time to frequency don	nain and vice vers	6
		help of heuristic (Ziegler-Nichols) tuning rules	;	
		control loops with the help of root locus and f		e techniques
	• They can calculate discrete-time app	roximations of controllers designed in cor	ntinuous-time an	d use it for digi
	implementation			
	 They can use standard software tools (M 	atlab Control Toolbox, Simulink) for carrying o	out these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly sol	ve technical problems, and experimentally va	lidate their contro	oller designs
Autonomy	Students can obtain information from provide	d sources (lecture notes, software document	tation, experimer	nt guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-I	line tests and thereby control their learning pr	ogress.	
	·····,···,···, -····		- 5	
Workload in Hours	Independent Study Time 124, Study Time in Le	cturo EG		
Credit points	Independent Study Time 124, Study Time in Le			
Course achievement				
	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program	7 competer): Caro Qualification: Compulson		
Following Curricula				
	Chemical and Bioprocess Engineering: Core Qu			
	Data Science: Core Qualification: Elective Comp			
	Data Science: Specialisation II. Application: Elec	ctive Compulsory		
	Electrical Engineering: Core Qualification: Comp	pulsory		
	Energy and Environmental Engineering: Core Q			
	Green Technologies: Energy, Water, Climate: Co			
	Computer Science in Engineering: Core Qualific Integrated Building Technology: Core Qualificat			
	Logistics and Mobility: Specialisation Engineerin			
	Logistics and Mobility: Specialisation Informatio			
	Logistics and Mobility: Specialisation Traffic Pla			
	Logistics and Mobility: Specialisation Production	n Management and Processes: Elective Compu	Ilsory	
	Mechanical Engineering: Core Qualification: Cor	mpulsory		
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Enginee		Commute	
	Theoretical Mechanical Engineering: Technical Process Engineering: Core Qualification: Compu		compulsory	
			hnology: Elective	Compulson
		cs and Mobility' Specialisation information io		
		cs and Mobility: Specialisation Information Teo cs and Mobility: Specialisation Traffic Planning		
	Engineering and Management - Major in Logisti Engineering and Management - Major in Logisti Engineering and Management - Major in Logis	cs and Mobility: Specialisation Traffic Planning	and Systems: El	ective Compulsory

Course L0654: Introduction t	o Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems
	Linear systems, differential equations and transfer functions
	 First and second order systems, poles and zeros, impulse and step response
	Stability
	Feedback systems
	Principle of feedback, open-loop versus closed-loop control
	Reference tracking and disturbance rejection
	Types of feedback, PID control
	System 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 t	ourse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

6				
Courses				
Title Management Tutorial (L0882)		Typ Recitation Section (small)	Hrs/wk 2	CP 3
Introduction to Management (L0882)	0)	Lecture	3	3
Module Responsible				
Admission Requirements	None		-	
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	5			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	After taking this module, students know the importa and Organisation to Marketing and Innovation, and a			
Skille	 explain the differences between Economic important definitions from the field of Manage explain the most important aspects of and g projects describe and explain basic business functior organization and human ressource managem explain the relevance of planning and decuncertainty, and explain some basic methods state basics from accounting and costing and Students are able to applyce business units with rescuerce of the second secon	ement ioals in Management and name the most ons as production, procurement and si ent, information management, innovation ision making in Business, esp. in situa from mathematical Finance selected controlling methods.	t important aspe ourcing, supply management ar tions under mul	ects of entreprneu chain manageme nd marketing Itiple objectives a
SKIIIS	Students are able to analyse business units with res out an Entrepreneurship project in a team. In particu		jectives, strateg	les etc.) and to ca
	 analyse Management goals and structure the analyse organisational and staff structures of apply methods for decision making under mu analyse production and procurement systems analyse and apply basic methods of marketin select and apply basic methods from mathem apply basic methods from accounting, costing 	companies Itiple objectives, under uncertainty and ur and Business information systems g atical finance to predefined problems	ıder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to a to communicate appropriately and to cooperate respectfully with their fellow stu Students are able to work in a team and to organize the team ther to write a report on their project. 	dents.	iherent report on	the project
	Independent Study Time 110, Study Time in Lecture	70		
Credit points				
Course achievement				
Examination	Subject theoretical and practical work several written exams during the semester			
scale	several written exams during the semester			
	General Engineering Science (German program, 7 se	amester): Core Qualification: Compulson		
Following Curricula	Civil- and Environmental Engineering: Specialisation			
j	Civil- and Environmental Engineering: Specialisation		sory	
	Civil- and Environmental Engineering: Specialisation	Traffic and Mobility: Elective Compulsory		
	Bioprocess Engineering: Core Qualification: Compute	ory		
	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulso	-		
	Computer Science in Engineering: Core Qualification			
	Integrated Building Technology: Core Qualification: (
	Logistics and Mobility: Core Qualification: Compulsor			
	Mechanical Engineering: Core Qualification: Computer	ьогу		
	Mechatronics: Core Qualification: Compulsory	nulson/		
	Orientation Studies: Core Qualification: Elective Com Orientation Studies: Core Qualification: Elective Com			
	Naval Architecture: Core Qualification: Elective Con	ipaisory		
	Technomathematics: Core Qualification: Compulsory	/		
	Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory			

Course L08	382: Management Tutorial
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload	Independent Study Time 62, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius
Language	DE
Cycle	WiSe/SoSe
Content	In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.
	If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on se
	selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busin
	knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

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

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

Тур	Seminar
Hrs/wk	1
CP	0
Workload in Hours	Independent Study Time -14, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried, Eilika Schwenke
Language	DE/EN
Cycle	WiSe/SoSe
Content	The aim of the internship-accompanying seminar is the acquisition and consolidation of competences relevant for successfully doing the advanced internship in the 7th semester. The target group is students who already have found an internship placement. The focus is on strengthening personal competences to support the successful development of professional competences. In the seminar, students reflect on current challenges in relation to the internship. They discuss current topics with fellow students and teachers with the method of collegial counselling (peer-to-peer approach); in this way they gain (additional) self-confidence and increase their chances of successfully contributing in the internship, recognising and expressing their own wishes and needs in order to optimally use the internship for their own theory-practice transfer. The selection of topics is process-oriented and controlled by the group; the teachers provide impulses for reflection on certain topics. Topics that are dealt with are, for example: Negotiating the employment contract, Successful start into the internship - how do I behave in the first few days, How do I get interesting tasks, How do I deal with difficult situations (e.g. conflicts, sexism, racism), How do I note my progress/write the internship report? Through the internship sof their ports the acquisition and consolidation of competences in career management skills that can be transferred to later career steps.
Literature	

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

Specialization Advanced Materials

Module M0662: Nume	erical Mathematics I
Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
Module Responsible	Prof. Sabine Le Borne
Admission Requirements	
-	
Recommended Previous Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematicia
Knowledge	basic MATLAB/Python knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root findir
	problems and to explain their core ideas,
	 repeat convergence statements for the numerical methods,
	 explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.
Skills	Students are able to
	 implement, apply and compare numerical methods using MATLAB/Python,
	 justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
	 select and execute a suitable solution approach for a given problem.
Personal Competence	
Social Competence	Students are able to
	work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.
Autonomy	Students are capable
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
	 to assess their individual progess and, if necessary, to ask questions and seek help.
	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination Examination duration and	
	90 minutes
Examination duration and scale	90 minutes
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory
Examination duration and scale Assignment for the	90 minutes 90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory
Examination duration and scale Assignment for the	90 minutes 90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory
Examination duration and scale Assignment for the	90 minutes 90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory
Examination duration and scale Assignment for the	 90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Scien
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Data Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systen Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systen Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Data Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Data Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science in Engineering: Core Qualification: Compulsory Engineering Science in Engineering: Core Qualification: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systen Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systen Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Grepulsory Gomeral Engineering: Specialisation II. Mathematics and Engineering: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Electrical Engineering: Specialisation II. Mathematics Compulsory Electrical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical E
Examination duration and scale Assignment for the	90 minutes General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

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

Course L0418: Numerical Mathematics I				
Тур	itation Section (small)			
Hrs/wk				
CP	3			
Workload in Hours	lependent Study Time 62, Study Time in Lecture 28			
Lecturer	f. Sabine Le Borne, Dr. Jens-Peter Zemke			
Language	N			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses				
litle		Тур	Hrs/wk	СР
undamentals of Materials Science	I (L1085)	Lecture	2	2
undamentals of Materials Science	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Ma	terials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Skills	phase transformations, corrosion and mechanical properties. Th for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws The students are able to trace materials phenomena back t phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidificatio between processing conditions and the materials microstructu	of nature. of nature. o the underlying ph ngth, ductility, and s n, precipitation, or r	properties. They are able sysical and chemical laws tiffness, chemical propertie melting. The students can	to trace materi of nature. Materi as such as corrosi explain the relat
Personal Competence Social Competence Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Mechan	ical Engineering: Compulso	iry
Following Curricula	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Data Science: Specialisation II. Application: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Ener Logistics and Mobility: Specialisation Engineering Science: Elect Logistics and Mobility: Specialisation Production Management a Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory	pecialisation Naval A pecialisation Advance y ergy Technology: Elec tive Compulsory	rchitecture: Compulsory ed Materials: Compulsory	' y

Course L0506: Fundamentals	s of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)				
Тур	ecture				
Hrs/wk	2				
СР	2				
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28				
Lecturer	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 C	Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Gregor Vonbun-Feldbauer
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 M0934: Adva	nced Materials for Sustainabil	litv			
		, ,			
Courses					
Title			Тур	Hrs/wk	CP
Advanced Materials Characterization			Lecture	2	2
Advanced Materials for Sustainability (L1091) Lecture 2			2		
Advanced Materials for Sustainabili			Recitation Section (large)	2	2
Module Responsible					
Admission Requirements					
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge					
Educational Objectives	After taking part successfully, students hav	ve reached the followi	ng learning results		
Professional Competence					
Knowledge	The students will be able to explain the pro-	operties of advanced	materials along with their a	pplications in tech	nology, in particula
	metallic, ceramic, polymeric, semiconducto	or, modern composite	materials (biomaterials) and	nanomaterials.	
Skills	The students will be able to select mater	-	-		
	materials considering architectural princip			-	
	modern materials science, which enables them to select optimum materials combinations depending on the technical application				chnical applications
Personal Competence					
-	The students are able to present solutions	to specialists and to o	develop ideas further.		
Autonomy	The students are able to				
	 assess their own strengths and weak 	knesses.			
	 define tasks independently. 				
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German p	program, 7 semeste	r): Specialisation Mechanica	al Engineering, F	ocus Biomechanics
Following Curricula	Compulsory				
	General Engineering Science (German prog	gram, 7 semester): Sp	ecialisation Advanced Mater	als: Compulsory	
	General Engineering Science (German	program, 7 semest	er): Specialisation Mechani	cal Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			- 5.	
	Engineering Science: Specialisation Mechar	nical Engineering: Ele	ctive Compulsory		
	Engineering Science: Specialisation Advance				
	Mechanical Engineering: Core Qualification		-		

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				
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 for Sustainability			
Lecture			
2			
2			
Independent Study Time 32, Study Time in Lecture 28			
Prof. Patrick Huber, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller			
DE/EN			
SoSe			
Vorlesungsunterlagen			

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

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Courses					
Title		Тур	Hrs/wk	СР	
Computational Mechanics (EN) (L23 Computational Mechanics (EN) (L23		Integrated Lecture Recitation Section (sma	4 II) 2	4	
Module Responsible		Rectation Section (Sind		L	
Admission Requirements	None				
Recommended Previous	Mathematics I-III and Engineering Mechan	cs I-III			
Knowledge					
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results			
Professional Competence					
Knowledge	The students can				
	 describe the axiomatic procedure u 	sed in mechanical contexts;			
	 explain important steps in model de 				
	 present technical knowledge. 				
Skills	The students can				
	 explain the important elements of mathematical / mechanical analysis and model formation, and apply it to th their own problems; apply basic methods from numerical mechanics to engineering problems; 				
		of the methods and extend them to be applic	able to wider problem	a coto	
	• estimate the reach and boundaries	of the methods and extend them to be applic		1 Sets.	
Personal Competence					
-	The students can work in groups and supp	ort each other to overcome difficulties.			
Autonomy	Students are capable of determining their	own strengths and weaknesses and to organ	ize their time and lear	rning based on those	
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Advanced	Materials: Compulsory		
Following Curricula	Engineering Science: Core Qualification: C	ompulsory			
Course L2398: Computationa					
	Integrated Lecture				
Hrs/wk	4				
СР	4				
Workload in Hours	Independent Study Time 64, Study Time in	n Lecture 56			
Lecturer	Dr. Alexander Held				

Lecturer	Dr. Alexander Held
Language	EN
Cycle	SoSe
Content	Part 1: Numerical Multibody Dynamics
	 Linear versus nonlinear vibration Numerical methods for time integration Concepts from analytical mechanics Spatial multibody systems Linearization of multibody systems Vibrations with multiple degrees of freedom: free, damped, forced, modal transformation Impacts Introduction to Matlab Part 2: Numerical Structural Mechanics
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 L2399: Computationa	ourse L2399: Computational Mechanics (EN)	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexander Held	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1730: Mathe	ematics IV (EN)			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	erential Equations) (EN) (L2783)	Lecture	2	1
Differential Equations 2 (Partial Diff	erential Equations) (EN) (L2784)	Recitation Section (large)	1	1
Differential Equations 2 (Partial Diff	erential Equations) (EN) (L2785)	Recitation Section (small)	1	1
Complex Functions (EN) (L2786)		Lecture	2	1
Complex Functions (EN) (L2787)		Recitation Section (large)	1	1
Complex Functions (EN) (L2788)		Recitation Section (small)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I - III (EN or DE)			
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge		Mathematics IV. They are able to explain the		
<i>Skills</i> Personal Competence <i>Social Competence</i>	 Students can model problems in Mathematics IV 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. 			
Autonomy	 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. Students are capable of checking their understanding of complex concepts on their own. They can specify open question precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
Workload in Hours	Independent Study Time 68, Study Time in Lect	uro 112		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120 min			
-	General Engineering Science (German program Computer Science: Specialisation II. Mathemati Data Science: Core Qualification: Elective Comp Data Science: Specialisation I. Mathematics/Cor Engineering Science: Specialisation Electrical El Engineering Science: Core Qualification: Compu	s and Engineering Science: Elective Compulso ulsory nputer Science: Elective Compulsory ngineering: Compulsory		
	Engineering Science: Core Qualification: Compu	lsory		

Course L2783: Differential Equations 2 (Partial Differential Equations) (EN)		
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	EN	
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 L2784: Differential Equations 2 (Partial Differential Equations) (EN)	
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	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2785: Differential E	urse L2785: Differential Equations 2 (Partial Differential Equations) (EN)	
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	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2786: Complex Fund	Course L2786: Complex Functions (EN)		
-	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	EN		
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		

ourse L2787: Complex Functions (EN)	
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	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2788: Complex Functions (EN)	
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	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Turn	Hrs /w/r	СР
Stochastics (L0777)		Typ Lecture	Hrs/wk 2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Matthias Schulte			
Admission Requirements	None			
Recommended Previous				
Knowledge	Calculus			
	Discrete algebraic structures (combinatorics)			
	Propositional logic			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
	 Students can name the basic concepts in Stoc 			
	 Students can discuss logical connections betw 	veen these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and can reproduce 	e them.		
Skills				
	Students can model problems from stochast		d in this course	. Moreover, they a
	capable of solving them by applying establish			
	Students are able to discover and verify further	-		
	 For a given problem, the students can deve results. 	op and execute a suitable approach, a	nd are able to c	ritically evaluate t
	Tesuits.			
Personal Competence				
Social Competence	Charlende and all the mostly be welled as (a. a. an bl			
	 Students are able to work together (e.g. on the different study programs and background known) 			
	different study programs and background knoIn doing so, they can communicate new conc			
	design examples to check and deepen the un		peracing partners	. Moreover, they c
		terstanding of their peers.		
Autonomy	Students are capable of checking their under	standing of complex concepts on their c	wn They can sn	ecify open questio
	precisely and know where to get help in solvir		with they can sp	celly open questio
	 Students can put their knowledge in relation t 			
	 Students have developed sufficient persister 		s in a goal-orien	ted manner on ha
	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
-	General Engineering Science (German program, 7 se			
Following Curricula	General Engineering Science (German program, 7 se	mester): Specialisation Advanced Materi	als: Elective Com	pulsory
	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory	als, Elective Compulsers		
	Engineering Science: Specialisation Advanced Mater			
	Engineering Science: Specialisation Electrical Engine Computer Science in Engineering: Core Qualification	,		
	Logistics and Mobility: Specialisation Engineering Sci			
	Logistics and Mobility: Specialisation Engineering Sci Logistics and Mobility: Specialisation Information Tec			
	Orientation Studies: Core Qualification: Elective Com			
	Theoretical Mechanical Engineering: Core Qualification			
	J J			

Course L0777: Stochastics		
	Laster and	
<i>,</i> ,	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Matthias Schulte	
Language	DE/EN	
Cycle	SoSe	
Content	 Definitions of probability, conditional probability Random variables Independence Distributions and density functions Characteristics: expectation, variance, standard deviation, moments Multivariate distributions Law of large numbers and central limit theorem Basic notions of stochastic processes Basic concepts of statistics (point estimators, confidence intervals, hypothesis testing) 	
Literature	 L. Dümbgen (2003): Stochastik für Informatiker, Springer. HO. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg. A.N. Shiryaev (2012): Problems in probability, Springer. 	

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

ourses				
itle		Тур	Hrs/wk	СР
ompanion Lecture for Materials S	-	Lecture	2	2
aterial Science Laboratory (L123	5)	Practical Course	4	4
Module Responsible	Prof. Kaline Pagnan Furlan			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of	the technical details of experiments in the	area of materials sc	iences and illust
	respective relationships. They are capable	of describing and communicating relevant p	problems and questio	ns using appropi
	technical language. They can explain the ty	pical process of solving practical problems an	d present related res	ults.
Chille	The students can transfer their fundamen	tel l'acudades en meteriel esiences te the an	access of column areas	tical problems 7
SKIIIS		tal knowledge on material sciences to the pro-		
	identity and overcome typical problems du	ring the realization of experiments in the conte		es.
Personal Competence				
Social Competence	Students are able to cooperate in small gro	oups in order to conduct experiments in the co	ntext of materials sci	ences. They are
	to effectively present and explain their resu	ults alone or in groups in front of a qualified au	idience.	
Autonomy		n the context of materials sciences using pro	-	y are able to fill g
		the literature and other sources provided by th	le supervisor.	
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Consulta on a locate				
Credit points				
Course achievement				
Course achievement Examination	Subject theoretical and practical work	tion looving modulo with integrated even	control	
Course achievement Examination Examination duration and	Subject theoretical and practical work Test reports on the respective tests and on	line learning modules with integrated success	control	
Course achievement Examination Examination duration and scale	Subject theoretical and practical work Test reports on the respective tests and on			broduct Davalan
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro-	line learning modules with integrated success gram, 7 semester): Specialisation Mechanical		Product Developr
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory	gram, 7 semester): Specialisation Mechanical	Engineering, Focus F	Product Developr
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory General Engineering Science (German pro-	gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Advanced Ma	Engineering, Focus F aterials: Compulsory	·
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory General Engineering Science (German pro- General Engineering Science (German	gram, 7 semester): Specialisation Mechanical	Engineering, Focus F aterials: Compulsory	·
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory General Engineering Science (German pro- General Engineering Science (German Engineering Sciences: Compulsory	gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Advanced Ma program, 7 semester): Specialisation Mech	Engineering, Focus F aterials: Compulsory	
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory General Engineering Science (German pro- General Engineering Science (German Engineering Sciences: Compulsory Engineering Science: Specialisation Advance	gram, 7 semester): Specialisation Mechanical rram, 7 semester): Specialisation Advanced Ma program, 7 semester): Specialisation Mech red Materials: Compulsory	Engineering, Focus F aterials: Compulsory nanical Engineering,	·
Course achievement Examination Examination duration and scale Assignment for the	Subject theoretical and practical work Test reports on the respective tests and on General Engineering Science (German pro- and Production: Elective Compulsory General Engineering Science (German pro- General Engineering Science (German Engineering Sciences: Compulsory Engineering Science: Specialisation Advance Mechanical Engineering: Specialisation Pro-	gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Advanced Ma program, 7 semester): Specialisation Mech	Engineering, Focus F aterials: Compulsory nanical Engineering,	

Course L1088: Companion Lecture for Materials Science Laboratory			
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Kaline Pagnan Furlan		
Language	DE/EN		
Cycle	WiSe		
Content	- Introduction to the Materials Science Laboratory practical course and learning modules;		
	- Collection of data: source of errors and sample distribution;		
	- Error calculation;		
	- Report writing and presentation of results;		
	- Graph plotting using software(s).		
Literature	1) W.D. Callister, Materials science and engineering: an introduction, Wiley 2000 https://katalog.tub.tuhh.de/Record/270018409 or		
	https://katalog.tub.tuhh.de/Record/1696922097 (online link at 'Exemplare')		
	2) John R. Taylor, Fehleranalyse: eine Einführung in die Untersuchung von Unsicherheiten in physikalischen Messungen, 1. Aufl.,		
	VCH Verlag, 1988 https://katalog.tub.tuhh.de/Record/027422038 // An Introduction to Error Analysis: The Study of Uncertainties		
	in Physical Measurements, 2d Edition, University Science Books, 1997 https://katalog.tub.tuhh.de/Record/024511676		
	<u> </u>		

Course L1235: Material Scien	ice Laboratory
Тур	Practical Course
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Kaline Pagnan Furlan, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Bodo Fiedler, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE/EN
Cycle	WiSe
Content	5 laboratory experiments:
	- Metals: Tensile test
	- Plastics: Scanning electron microscopy on fracture surfaces of fiber reinforced plastics
	- Plastics: Bending test - bending properties of carbon fiber reinforced plastics
	- Ceramics: Ceramic synthesis - From raw material up to sintered product
	- Ceramics: Mechanical testing - hardness and fracture toughness of ceramic materials
Literature	1) Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II
	2) W.D. Callister, Materials science and engineering: an introduction, Wiley 2000 https://katalog.tub.tuhh.de/Record/270018409 or https://katalog.tub.tuhh.de/Record/1696922097 (online link at 'Exemplare')

Module M1808: Quan	tum Mechanics for Materials Sci	ence		
Courses				
Title		Тур	Hrs/wk	СР
Atomic-Scale Fundamentals of Materials Science (L2989)		Lecture	2	3
Atomic-Scale Fundamentals of Mat	erials Science (L2990)	Recitation Section (large)	2	3
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Advanced Ma	erials: Compulsory	
Following Curricula	Engineering Science: Specialisation Advanced I	laterials: Compulsory		
	Engineering Science: Specialisation Advanced I	Aaterials: Elective Compulsory		

Course L2989: Atomic-Scale	Course L2989: Atomic-Scale Fundamentals of Materials Science		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	NN		
Language	EN		
Cycle	WiSe/SoSe		
Content			
Literature			

Course L2990: Atomic-Scale	ourse L2990: Atomic-Scale Fundamentals of Materials Science		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	NN		
Language	EN		
Cycle	WiSe/SoSe		
Content			
Literature			

Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (EN) (L2383)		Lecture	3	4 2
Fluid Mechanics (EN) (L2384)		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements				
Recommended Previous	Sound knowledge of engineering mathematics, eng	ineering mechanics and thermodynamics.		
Knowledge	After taking part successfully, students have reach	ed the following learning regults		
Educational Objectives	After taking part successfully, students have reach	ad the following learning results		
Professional Competence	Students will have the required sound knowledge	a to ovalain the conoral principles of flui	d onginooring o	nd physics of fluid
Knowledge	Students can scientifically outline the rationale of			
	performance analysis and the prediciton of fluid en			
	······································			
Skills	Students are able to apply fluid-engineering princi			-
	enables the student to carry out all necessary the	eoretical calculations for the fluid dynamic	design of engir	neering devices on
	scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and join	tly develop solution strategies.		
4	The shudents are able to develop ask the shusterio	- 6		
Autonomy	The students are able to develop solution strategie	s for complex problems self-consistent and	crtically analyse	results.
Workload in Hours	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Advanced Materia	ls: Compulsory	
Following Curricula	Engineering Science: Core Qualification: Compulsor	У		
Course L2383: Fluid Mechan	ics (EN)			
Тур	Lecture			
Hrs/wk	3			
СР	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture	42		
Lecturer	NN			
Language	EN			

Language	EN
Cycle	WiSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	•

Course L2384: Fluid Mechani	urse L2384: Fluid Mechanics (EN)		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	NN		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses					
Title		Тур		Hrs/wk	СР
Practical Course: Measurement and	Control Systems (L1119)	Practical	Course	2	2
Measurement Technology for Mech	anical Engineering (L1116)	Lecture		2	3
Measurement Technology for Mech	anical Engineering (L1118)	Recitatio	n Section (large)	1	1
Module Responsible	Prof. Thorsten Kern				
Admission Requirements	None				
Recommended Previous	Basic knowledge of physics, chemistry and	electrical engineering			
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning	ng results		
Professional Competence					
Knowledge	Students are able to name the most impo	rtant fundmentals of the Meas	surement Technolog	y (Quantities and	I Units, Uncertain
	Calibration, Static and Dynamic Properties	of Sensors and Systems).			
	They can outline the most important mea	suring methods for different k	inds of quantities to	o be maesured (F	Electrical Quantiti
	Temperature, mechanical quantities, Flow		and of quantities t	o be macsarea (i	
		inne, i requeirey,			
	They can describe important methods of cl	emical Analysis (Gas Sensors,	Spectroscopy, Gas (Chromatography)	
Skills	Students can select suitable measuring me	thods to given problems and c	an use refering mea	surement devices	s in practice.
	The students are able to orally explain iss	ues in the subiect area of mea	surement technolog	v and solution an	pproaches as well
	place the issues into the right context and			,,	
	·····				
Personal Competence					
Social Competence	Students can arrive at work results in grou	e Students can arrive at work results in groups and document them in a common report.			
			inite in tep of the		
			epore		
Autonomy	Students are able to familiarize themselves	with new measurement techn			
Workload in Hours	Independent Study Time 110, Study Time i				
Workload in Hours Credit points					
Workload in Hours	Independent Study Time 110, Study Time i 6	n Lecture 70 Description			
Workload in Hours Credit points	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form	n Lecture 70 Description			
Workload in Hours Credit points Course achievement	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic	n Lecture 70 Description			
Workload in Hours Credit points Course achievement	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work	n Lecture 70 Description			
Workload in Hours Credit points Course achievement Examination	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work	n Lecture 70 Description			
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work	n Lecture 70 Description al and	ologies.	eering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes	n Lecture 70 Description al and ram, 7 semester): Specialisatio	ologies. on Mechanical Engin		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German proc	n Lecture 70 Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog	n Lecture 70 Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog	n Lecture 70 Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali	Description Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory	ologies. on Mechanical Engin on Biomedical Engin	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory	ologies. on Mechanical Engin on Biomedical Engin	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Biomedian	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory nical Engineering: Compulsory lical Engineering: Elective Com	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia	eering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Biomed Engineering Science: Specialisation Advance	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory nical Engineering: Compulsory lical Engineering: Elective Compuls ed Materials: Elective Compuls	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia pulsory cory	eering: Compulso als: Elective Comp	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Advance General Engineering Science (English prog	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory nical Engineering: Compulsory lical Engineering: Elective Com ed Materials: Elective Compuls am, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia pulsory :ory n Mechatronics: Cor	eering: Compulso als: Elective Comp npulsory	ry bulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Advance General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory nical Engineering: Compulsory lical Engineering: Elective Com ed Materials: Elective Compuls am, 7 semester): Specialisatio am, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia pulsory :ory n Mechatronics: Cor n Mechanical Engine	eering: Compulso als: Elective Comp npulsory eering: Compulsor	ry bulsory Y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Advance General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory ronics: Compulsory nical Engineering: Compulsory lical Engineering: Elective Compuls am, 7 semester): Specialisatio am, 7 semester): Specialisatio am, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia pulsory :ory n Mechatronics: Cor n Mechanical Engine n Biomedical Engine	eering: Compulso als: Elective Comp npulsory eering: Compulsor eering: Elective Co	ry bulsory Y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time i 6 Compulsory Bonus Form Yes None Subject theoretic practical work Subject theoretical and practical work 105 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Digital Mechanical Engineering: Core Quali Energy and Environmental Engineering: Core Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Mecha Engineering Science: Specialisation Advance General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog Logistics and Mobility: Specialisation Produ	Description al and ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ication: Compulsory re Qualification: Compulsory nical Engineering: Compulsory lical Engineering: Elective Compuls am, 7 semester): Specialisatio am, 7 semester): Specialisatio am, 7 semester): Specialisatio am, 7 semester): Specialisatio cam, 7 semester): Specialisatio cam, 7 semester): Specialisatio cam, 7 semester): Specialisatio	ologies. on Mechanical Engin on Biomedical Engin on Advanced Materia pulsory :ory n Mechatronics: Cor n Mechanical Engine n Biomedical Engine	eering: Compulso als: Elective Comp npulsory eering: Compulsor eering: Elective Co	ry bulsory Y
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	rse: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseou pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine w be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications wi Michelson interferometer and optical fibers demonstrated.
Literature	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Auf Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltun Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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

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

Courses				
Title		Тур	Hrs/wk	СР
Statistics (L2430)		Lecture	3	4
Statistics (L2431)		Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Schulte			
Admission Requirements	None			
Recommended Previous	Stochastics (or a comparable class)			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Sta			
	Students can discuss logical connections be	tween these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
Skills				
	 Students can model statistical problems with 			, they are capable
	solving them by applying established metho			
	 Students are able to discover and verify furth 	-		
	 For a given problem, the students can dev 	elop and execute a suitable approach, a	nd are able to c	ritically evaluate
	results.			
Personal Competence				
Social Competence				
	Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the second			
	their results appropriately (e.g. during exerc	se class).		
	 In doing so, they can communicate new con 	cepts according to the needs of their coop	erating partners	. Moreover, they
	design examples to check and deepen the u	nderstanding of their peers.		
Autonomy				
	 Students are capable of checking their under the students are capable of checking the students are students. 	erstanding of complex concepts on their o	wn. They can sp	ecify open questi
	precisely and know where to get help in solv	ing them.		
	 Students can put their knowledge in relation 	to the contents of other lectures.		
	 Students have developed sufficient persister 	nce to be able to work for longer period	s in a goal-orien	ted manner on h
	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
-	General Engineering Science (German program, 7 s			
Following Curricula	General Engineering Science (German program, 7 s			ulsory
	Computer Science: Specialisation II. Mathematics a	nd Engineering Science: Elective Compulso	ory	
	Data Science: Core Qualification: Compulsory			
	Engineering Science: Specialisation Advanced Mate			
	Logistics and Mobility: Specialisation Information Te			
	Technomathematics: Specialisation I. Mathematics:			
	Theoretical Mechanical Engineering: Specialisation			
	Engineering and Management - Major in Logistics a	nd Mobility: Specialisation Information Tec	hnology: Elective	e Compulsory

Course L2430: Statistics		
Тур	Lecture	
Hrs/wk	3	
CP		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Matthias Schulte	
Language	DE/EN	
Cycle	WiSe	
Content	 Multivariate distributions and stochastic convergence Point estimators Confidence intervals Hypothesis testing Nonparametric statistics Linear Regression Time series analysis Statistical software (R) 	
Literature	 L. Dümbgen (2016): Einführung in die Statistik, Birkhäuser. L. Dümbgen (2003): Stochastik für Informatiker, Springer. HO. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg. 	

Course L2431: Statistics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1807: Mach	ine Learning for Physical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Machine Learning for Physical System	ems (L2987)	Lecture	2	3
Machine Learning for Physical System	ems (L2988)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Christian Cyron			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Sp	ecialisation Advanced Materials:	Compulsory	
Following Curricula	Engineering Science: Specialisation Advanced Materials: Compu	lsory		
	Engineering Science: Specialisation Advanced Materials: Elective	e Compulsory		

Course L2987: Machine Learning for Physical Systems		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	WiSe/SoSe	
Content		
Literature		

Course L2988: Machine Lear	ourse L2988: Machine Learning for Physical Systems		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	NN		
Language	EN		
Cycle	WiSe/SoSe		
Content			
Literature			

Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L	0925)	Lecture	2	3
Quality Management (L0926)		Lecture	2	3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the conten	ts of the lecture of the module.		
Skills	Students are able to apply the methods	and models in the module to industrial probler	ms.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mech	anical Engineering, Foo	us Aircraft Syste
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mechanic	cal Engineering, Focus F	roduct Developm
	and Production: Compulsory			
		rogram, 7 semester): Specialisation Advanced	Materials: Elective Com	pulsory
	Engineering Science: Core Qualification			
	Engineering Science: Specialisation Med			
		hanical Engineering: Elective Compulsory		
	Engineering Science: Specialisation Adv			
		oduction Management and Processes: Compuls	ory	
	Logistics and Mobility: Specialisation En			
	Mechanical Engineering: Core Qualificat	ion: Elective Compulsory Logistics and Mobility: Specialisation Production		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Modeling, Simulation and Optimiza	tion (EN) (L2446)	Integrated Lecture	4	6
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathe	matics, engineering mechanics and fluid mechan	ics	
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students will have an overview of varie	ous technical problems and the differential equa	tions, which describe	them. Students
	gave an overview of different solution a	pproaches and for which kind of problems they ca	an be used for.	
Skills	Students are able to solve different tech	nnical problems with the introduced discretization	methods	
Skiiis	Students are able to solve different teer	inical problems with the incloduced discretization	methous.	
Personal Competence				
Social Competence	The students are able to discuss probler	ms and jointly develop solution strategies.		
Autonomy	The students are able to develop solution	on strategies for complex problems self-consistent	t and critically analyse	results
Autonomy		should be complex problems set consistent	cana encicany analyse	results.
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	General Engineering Science (German p	program, 7 semester): Specialisation Mechanical I	Engineering, Focus Th	eoretical Mechan
Following Curricula	Engineering: Compulsory			
		program, 7 semester): Specialisation Advanced Ma		
		n program, 7 semester): Specialisation Mechan	ical Engineering, Foc	us Aircraft Syste
	Engineering: Elective Compulsory			
	Engineering Science: Core Qualification			
		Theoretical Mechanical Engineering: Compulsory Engineering Science: Elective Compulsory		

Course L2446: Modeling, Simulation and Optimization (EN)		
Тур	Integrated Lecture	
Hrs/wk		
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried	
Language	EN	
Cycle	SoSe	
Content	 Partial Differential Equations in technical problems Overview of modelling approaches Finite Approximation Methods - Finite Differences / Elements / Volumes Introduction to the Discrete Element Method Numerical methods for time dependent problems Gradient-based optimization 	
Literature	Michael Schäfer, Computational Engineering - Introduction to Numerical Methods, Springer.	

Гitle		Тур	Hrs/wk	СР	
Electromagnetics for Engineers I: Time-Independent Fields (L2281)		Lecture	3	5	
ectromagnetics for Engineers I: Til	I: Time-Independent Fields (L2282) Recitation Section (small) 2 1				
Module Responsible	Dr. Cheng Yang				
Admission Requirements	None				
	Basic principles of electrical engineering and advar	nced mathematics			
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence					
	They can explicate the principal behavior of elect sources. They can describe the properties of con fields. The students are aware of applications for t these.	nplex electromagnetic fields by means of	superposition of	solutions for sim	
	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independe electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwe Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields a analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, a electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical application				
Personal Competence					
	Students are able to work together on subject related tasks in small groups. They are able to present their results effectively (e.g during exercise sessions).				
	· · ·	ted tasks in small groups. They are able to	present their re		
Autonomy	· · ·	tion from provided references and relate thins of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t	s information to such as short or are expected to a	sults effectively (e the lecture. They a ral quizzes during t adjust their individu	
Autonomy	during exercise sessions). Students are capable to gather necessary informat able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw connection	tion from provided references and relate this ns of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t ra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a ral quizzes during t adjust their individu	
Autonomy	during exercise sessions). Students are capable to gather necessary informat able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw connection lectures (e.g. Electrical Engineering I, Linear Algebrind Independent Study Time 110, Study Time in Lecture	tion from provided references and relate this ns of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t ra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a ral quizzes during t adjust their individu	
Autonomy Workload in Hours	during exercise sessions). Students are capable to gather necessary informat able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw connected lectures (e.g. Electrical Engineering I, Linear Algebri Independent Study Time 110, Study Time in Lectur 6	tion from provided references and relate this ns of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t ra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during f adjust their individ	
Autonomy Workload in Hours Credit points	during exercise sessions). Students are capable to gather necessary informat able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw connection lectures (e.g. Electrical Engineering I, Linear Algebric Independent Study Time 110, Study Time in Lecture 6 None	tion from provided references and relate this ns of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t ra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during i adjust their individ	
Autonomy Workload in Hours Credit points Course achievement	during exercise sessions). Students are capable to gather necessary informat able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw connection lectures (e.g. Electrical Engineering I, Linear Algebri Independent Study Time 110, Study Time in Lecture 6 None Written exam	tion from provided references and relate this ns of activities that accompany the lecture, n. Based on respective feedback, students a ons between their knowledge obtained in t ra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during f adjust their individ	

Course L2281: Electromagnet	tics for Engineers I: Time-Independent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
	Dr. Cheng Yang, Prof. Christian Schuster
Language	
Cycle	
Content	- Maxwell's Equations in integral and differential notation
	- Boundary conditions
	- Laws of conservation for energy and charge
	- Classification of electromagnetic field properties
	- Integral characteristics of time-independent fields (R, L, C)
	- Generic approaches to solving Poisson's Equation
	- Electrostatic fields and specific methods of solving
	- Magnetostatic fields and specific methods of solving
	- Fields of electrical current density and specific methods of solving
	- Action of force within time-independent fields
	- Numerical methods for solving time-independent problems
	The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs.
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Course L2282: Electromagnetics for Engineers I: Time-Independent Fields		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Cheng Yang, Prof. Christian Schuster	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title			Тур	Hrs/wk	СР
Materials and Process Modeling (L2862)			Lecture	3	3
Materials Selection and Processing (L2861)			Lecture	3	3
Module Responsible	Prof. Norbert Huber				
Admission Requirements	None				
Recommended Previous	Fundamentals of mathematics (differential equations, integration), materials science (classes of materials, structure, propertie				
Knowledge	tensile test) and engi	neering mechanics (s	tress, strain, elasticity, deformation).		
Educational Objectives	After taking part succ	essfully, students hav	ve reached the following learning results		
Professional Competence					
Knowledge	material processing,	the associated micros	d properties of engineering materials. Part structure and the achievable mechanical pr mic efficiency. Metallic materials are in the vailable materials.	roperties. In conjunction	with the costs, the
	laws for plasticity und also plays a major r	der monotonic and cy ole in manufacturing	nsideration, the modeling of material beha clic loading is worked out. In addition to the processes and thus provides the basis uring processes, such as rolling or forming,	e evaluation of componer for process simulation.	nt behavior, plastic Process models a
Skills	Students are able to				
	 analyze the material behavior of metallic materials for general load histories with respect to elasticity and as the associated velocity-dependent material behavior and describe it with corresponding material laws to relate the deformation behavior to the underlying microstructural mechanisms to assess how processing procedures affect the chain microstructure - process - properties understand how the mechanical properties of metallic materials can be tailored by the processing due to design 				
Personal Competence					
-	Students are able to				
	develop solution		e by contributing to the discussion. and explain them in English in the plenum	and discuss them with tl	heir fellow student
Autonomy	Students are able to,				
	 assess their own strengths and weaknesses concretely assess their respective learning status and define further work steps on this basis abstract given tasks and then apply them to new problems by transferring the taught material. 				
Workload in Hours	Independent Study Ti	me 96, Study Time in	Lecture 84		
Credit points	6				
Course achievement	CompulsoryBonusYes20 %	Form Excercises	Description Wir stellen Übungsaufgaben (ÜA), den wöchentlichen Übungen vorg bis zu 20% bei der Prüfung berück	estellt werden. Diese kör	
Examination	Written exam				
Examination duration and	120 min				
scale					
			program, 7 semester): Specialisation M	lechanical Engineering,	Focus Materials
Following Curricula	Engineering Sciences: Compulsory				
			gram, 7 semester): Specialisation Advanced	i Materials: Compulsory	
			nical Engineering: Elective Compulsory		
	Engineering Science: Specialisation Advanced Materials: Compulsory Engineering Science: Specialisation Advanced Materials: Compulsory				
			terials in Engineering Sciences: Compulsory		

Course L2862: Materials and	Process Modeling
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Norbert Huber
Language	EN
Cycle	SoSe
Content	 Relevance of plasticity in materials processing and operation Fundamentals of plasticity in metals and alloys Modellierung von Materialverhalten Plasticity in cyclic loading Rate dependency, recristallization Rolling, forming, and solid state joining processes Residual stress design
Literature	 Hull and Bacon: Introduction to Dislocations (1984) G. Gottstein: Physik. Grundlagen der Materialk. (2001) P. Haupt: Cont. Mechanics and Theory of Materials (2002) N. Huber: Vorlesungsskript "Grundlagen der mechanischen Eigenschaften von Werkstoffen", TUHH

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

Specialization Civil Engineering

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

Module M0580: Princ	ples of Building Materials ar	nd Building Physics			
Courses					
Title	Тур		Hrs/wk	СР	
Building Physics (L0217)		Lecture		2	2
Building Physics (L0219)		Recitation Sec	tion (large)	1	1
Building Physics (L0247)		Recitation Sec	tion (small)	1	1
Principles of Building Materials (L02	215)	Lecture		2	2
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous	Knowledge of physics, chemistry and mat	hematics from school			
Knowledge					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning re	sults		
Professional Competence					
Knowledge	The students are able to identify fundame	ental effects of action to materials an	d structures, to ex	plain different	types of mechanica
	behaviour, to describe the structure of	building materials and the correl	ations between s	tructure and	other properties, to
	show methods of joining and of corrosio	n processes and to describe the mo	ost important regu	larities and p	roperties of building
	materials and structures and their measu	rement in the field of protection agai	nst moisture, coldi	ness, fire and	noise.
CI-:!!-	The should also an able to mode with the s			the field of	
SKIIIS	The students are able to work with the m		-		moisture protection
	the German regulation for energy saving,	fire protection and noise protection	n the case of a sm	iali bullding.	
Personal Competence					
Social Competence	The students are able to support each oth	er to learn the very extensive specia	list knowledge.		
4	The shudents are able to usely the time'r s				utanalisa Galal
Autonomy	The students are able to make the timing	and the operation steps to learn the	specialist knowled	ige of a very e	extensive field.
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84			
Credit points					
Course achievement					
	Written exam				
Examination duration and					
scale					
	General Engineering Science (German pro	ogram. 7 semester): Specialisation Ci	vil Engineering: Co	ompulsory	
Following Curricula		-		,,	
	Integrated Building Technology: Core Qua				
	Orientation Studies: Core Qualification: El				
	Technomathematics: Specialisation III. En)rv		
	recimonaulematics. Specialisation III. Ell	gineering science. Liecuve Compulsi	лу		

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

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

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

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

Courses					
Title			Тур	Hrs/wk	СР
Structural Analysis I (L0666)			Lecture	2	3
Structural Analysis I (L0667)			Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterl	e			
Admission Requirements	None				
Recommended Previous	Mechanics I, Mathen	natics I			
Knowledge					
Educational Objectives	After taking part suc	cessfully, students have re	ached the following learning results		
Professional Competence					
Knowledge	After successfully co	mpleting this module, stud	ents can express the basic aspects of linear	frame analysis of s	tatically determina
	systems.				
CL ///					
Skills			e students are able to distinguish between s	-	
	-		riables and to construct influence lines of s	statically determina	ite plane and spat
	frame and truss stru	ctures.			
Personal Competence					
Social Competence	Students can				
	 participate in 	subject-specific and interd	isciplinary discussions,		
		own work results in front of			
	 promote the s 	scientific development of co	olleagues		
	 Furthermore, 	they can give and accept p	professional constructive criticism		
Autonomy			k assignments. Due to the in-term feedback	k, they are enabled	to self-assess the
	learning progress du	iring the lecture period, alr	eady.		
Workload in Hours	Independent Study 1	Гіте 124, Study Time in Le	cture 56		
Credit points	6	-			
Course achievement	Compulsory Bonus	Form	Description		
	No 10%	Written elaboration	Hausübungen mit Testat, betreut durch	Studentische Tutor	en (Tutorium)
Examination	Written exam				
Examination duration and	90 minutes				
scale					
Assignment for the	General Engineering	Science (German program	, 7 semester): Specialisation Civil Engineerir	ng: Compulsory	
Following Curricula		ental Engineering: Core Qua			
-	Logistics and Mobilit	y: Specialisation Traffic Pla	nning and Systems: Elective Compulsory		
	-		ring Science: Elective Compulsory		
			cs and Mobility: Specialisation Traffic Planni	and Systems: El	active Compulsory

Course L0666: Structural An	alysis I					
Тур	Lecture					
Hrs/wk						
CP						
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28					
Lecturer	Prof. Bastian Oesterle					
Language	DE					
Cycle	WiSe					
Content	Statically determinate structural systems					
	 modelling of structures theory of plane and spacial structures assessment of structural behaviour, degree of static indeterminacy and kinematics analysis of forces and moments, as well as diplscements and rotations principle of virtual work influence lines 					
Literature	 Vorlesungsmanuskript Bletzinger et al.: Aufgabensammlung zur Baustatik: Übungsaufgaben zur Berechnung ebener Stabtragwerke. Hanser. Dinkler: Grundlagen der Baustatik. Springer. Marti: Baustatik. Ernst und Sohn. 					

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

Module M0590: Buildi	ng Materials a	nd Building	Chemistry			
	3		-			
Courses						
Title				Тур	Hrs/wk	СР
Building Materials and Building Che	-			Lecture	4	4
Building Materials and Building Che	nistry (L0249)			Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-D	Döhl				
Admission Requirements	None					
Recommended Previous	Module Principles of I	Building Materials	and Building Physics			
Knowledge						
Educational Objectives	After taking part succ	cessfully, students	s have reached the fo	llowing learning results		
Professional Competence						
Knowledge	The students are a	able to explain t	he most important	components, the manufactu	re, the structure,	the most importan
	characteristics of the	e mechanical beh	aviour and the corro	sion behaviour, the material t	esting and the field	ds of utilization of a
	relevant building mat	terials.				
Skills	The students are able to assess the usability of building materials for different applications and to select building materials					
	according to their spe	ecific advantages	and disadvantages.	The students are able to prepa	re the mixture of a	normal type concret
	and to consider the	mixture in respec	t to the actual rules	and the connections between	the characteristic	concrete parameters
	They are able to select suitable materials and mixtures to avoid damage processes.					
Personal Competence						
-	The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry out					
	exercises in small groups in the lab.					
	exercises in sindir gre	oups in the lub.				
Autonomu	The students are able	a ka waalka khaa kiwai	ing and the energies	, stops to loove the specialist h		utoncius field
Autonomy	The students are able	e to make the tim	ing and the operation	steps to learn the specialist k	nowledge of a very of	extensive neid.
Workload in Hours	Independent Study T	ime 110, Study Ti	me in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Descriptio	on		
	No 10 %	Presentation				
Examination	Written exam					
Examination duration and	2 h written exam					
scale						
Assignment for the	General Engineering	Science (German	program, 7 semester): Specialisation Civil Engineer	ing: Compulsory	
Following Curricula	Civil- and Environme	ntal Engineering:	Core Oualification: Co	moulcon		
Following curricula				Jiipuisory		
	Integrated Building T	echnology: Core C				

Course L0248: Building Mate	rials and Building Chemistry
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Cementing materials, aggregates, admixtures and other components in mortar and concrete, concrete, durability of cement
	bonded materials, repair of concrete structures, steel, cast iron, non-ferrous metals,
	metal corrosion, timber, plastics, natural stone, synthetic stones, mortar, masonry, glass, bitumen
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3
	Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8
	Henning, O.; Knöfel, D.: Baustoffchemie. ISBN 3-345-00799-1
	Knoblauch, H.; Schneider, U.: Bauchemie. ISBN 3-8041-5174-4

Course L0249: Building Mate	Course L0249: Building Materials and Building Chemistry				
Тур	Recitation Section (small)				
Hrs/wk	1				
CP	2				
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14				
Lecturer	f. Frank Schmidt-Döhl, Andre Rössler				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Courses						
Fitle				Тур	Hrs/wk	СР
Project Seminar Concrete I (L0896)				Seminar	1	1
Reinforced Concrete Design I (L030	3)			Lecture	2	3
Reinforced Concrete Design I (L030	5)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombac	ch				
Admission Requirements	None					
Recommended Previous	Basic knowledge in s	structural analysis and	l building materials.			
Knowledge						
	Modules: Structural	Analysis I, Mechanics	1+11			
Educational Objectives	After taking part suc	ccessfully, students ha	ve reached the followin	g learning results		
Professional Competence						
Knowledge	The students can ou	utline the history of co	ncrete construction and	l explain the basics of strue	tural engineering,	including usual lo
-	combinations and sa	afety concepts. They a	are able to draft and dir	mension simple structures,	as well as to eval	uate and discuss
		terials and of structura				
Chille	The students are sh		aduras of the conception	and dimensioning to pro-	atical assas They	ara sanahla ta di
Skills	Skills The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing the structures are the structures and to design them for bending and bending with axial force.					
						their detailing a
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.					
Personal Competence						
Social Competence						
Autonomy	The students are abl	le to carry out simple t	tasks in the conception	and dimensioning of struct	ures and to critica	lly reflect the resu
Workload in Hours	Independent Study 7	Time 110, Study Time	in Lecture 70			
	6					
Course achievement	Compulsory Bonus	Form	Description			
course demeterment	No None	Excercises				
Examination	Written exam					
Examination duration and	120 minutes					
scale						
	Conoral Engineering	Science (Corman pro	aram 7 comostor): Soc	cialication Civil Engineering	a: Compulsory	
-	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory					
Following Curricula	Civii- anu Environme	entai Engineering: Core	e quanneacion: comput	зогу		
Ourso 10896: Broject Comin	ar Concroto I					
<i>,</i> ,	ar Concrete I Seminar 1					

CP	1
Workload in Hours	Independent Study Time 16, 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	Download der Unterlagen zur Vorlesung über Stud.IP!

Course L0303: Reinforced Co	ncrete Design I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	The following subjects/contents are treated:
Literature	 history of concrete construction building materials: mechanical and physical-chemical properties of concrete, steel, GFRP, CFRP Introduction in safety concepts, ultimate limit states and safety coefficients actions on structures design of linear concrete members with arbitrary cross section for tension and bending with/without axial force design of slender columns Download der Unterlagen zur Vorlesung über Stud.IP! Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 König G., Tue N.: Grundlagen des Stahlbetonbaus, 3. Auflage, Teubner-Verlag, 2008 Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011
	 Fingerlos F., Hegger J., Zilch K.: Eurocode 2 für Deutschland. Berlin 2016 Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978

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

Courses View Network CP Structured Indepict IL0073) Kature 2 3 Module Responsible Port Bastian Construct 2 3 Recommended Previous None 1 1 Recommended Previous None 1 1 Recommended Previous None 1 1 Recommended Previous None 1 None interval Equations in the Mathematics III Mathematics III Mathematics III Mathematics III None interval Equations in the Mathematics III Professional Competence After taking part successfully, students have reached the following learning results Forfessional Competence Statis After successful completion of this module, students can express the basic agents of linear frame analysis of statis indeterminate systems. Indeterminate plane and spatial frame and trus structures. Statis After successful completion of this module, the students are able to analyze state variables and to construct influence line structure interval explores interval explo	Module M0744: Struc	ural Analysis II					
Advances of (10073) Letture 2 3 Mediate Responsibile Admission Requirements None 2 3 Recommented Recommented Provides None - - - Recommented Provides None - - - - Recommented Provides None -	Courses						
Bateural Analyse II. UD6/40 Receater Section (large) 2 3 Module Repear/ble More Administion Regularmanuta Home Recommended Provides International Equations II Internatenational International Equations II	Title				Тур	Hrs/wk	СР
Module Regensation Inst Dastan Gesterie Admission Requirements Recommended Previous Knowledge • Machanics (II • Machanics (II • Machanics (II) • Machanics (II) • Machanics (II) • Structural Analysis I Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge After successfull completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Versional Competence Students can • surticities in subject-specific and interdisciplinary discussions, • performed the common work results in foot of others • performed the common work results in foot of others • performed the common work results in foot of others • peremote the circetifi							
Admission Requirements None Recommended Previous • Mathematics (#) • Mathematics (#) • Mathematics (#) • Mathematics (#) • Offerential Equations I • Structural Analysis I • Structural Analysis I Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Statis After successful completion of this module, the students are able to analyze state variables and to construct influence line attically inderminate plane and spatial frame and truss structures. Statis After successful completion of this module, the students are able to analyze state variables and to construct influence line attically inderminate plane and spatial frame and truss structures. Personal Competence Students can Students can • participate in subject-specific and interdisciplinary discussions, • • elefond their own work results in front of others • participate in subject-specific and interdisciplinary discussions, • • elefond their own work results in front of others • participate in subject-specific and interdisciplinary discussions, • • elefond their own work results in front of others • participate to work in-term hore/seisonal constructive	Structural Analysis II (L0674)				Recitation Section (large)	2	3
Recommended Previous • Mechanics VII • Mechanics VII • Mechanics VII • Mechanics VII • Structural Analysis I • Structural Analysis I • Structural Analysis I • Structural Analysis I • Structural Analysis I • Professional Competence • Mechanics VII • Knowledge Metr successful completion of this module, students can express the basic aspects of linear frame analysis of static undeterminate systems. • Statical Competence Students can • statically inderminate plane and spatial frame and trus structures. • statically inderminate plane and spatial frame and trus structures. • entricipate in subject-specific and interdisciplinary discussions, • edend there one work results in foot of others • rundentize events the scientific development to construct influence lines are able to work in-term freedback, they are anabled to self-assess the analyze science activities • Autonomy The students are able to work in-term homework assignments, Due to the in-term feedback, they are anabled to self-assess the analyze science activities • Workload in Houri Independent Study Time 124, Study Time in Lecture 56 • Credit points General truther solution • Statients can 10 % Written elaboration • Statient can 10 % Written elaboration • Statienterminate 10 % Written elab		Prof. Bastian Oesterle					
Knowledge • Mechanics (II • Differential Equations I • Differential Equations I • Structural Analysis I • Structural Analysis I Professional Competence After successful completion of this module, students can express the basic aspects of linear frame analysis of static inderminate systems. After successful completion of this module, the students are able to analyze state variables and to construct influence linear statically inderminate plane and spatial frame and truss structures. Scill After successful completion of this module, the students are able to analyze state variables and to construct influence linear statically inderminate plane and spatial frame and truss structures. Scill Students can * participate in subject-specific and interdisciplinary discussions, • participate are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the learning progress during the lecture period, already. Workload in Hours Modependent Study Time 124, Study Time in Lecture 56 Course activeremt General Engineering Science (German program, 7 semester). Specialisation Civil Engineering: Compulsory Following Curricut Examination within exam 10 % Witten elaboration Hausibungen mil Testal, betreut durch Studentische Tutoren (Tutorium) Examination duration be study		None					
Addematics (III Highermatics (III Highermatics (III Highermatics (III Structural Analysis I After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Statis After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and trues structures. Statis After successful completion of others Social Completence Social Completence Students can • participate in subject-specific and interdisciplinary discussions, • defend their own work results in front of others • purports the science of colleagues • Furthermore, they can give and accest professional constructive criticism The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the teaming progress during the lecture period, already. Workload in Hours Independent Study Time 124, study Time in Lecture 56 Centre points Vorte analy 10 Examination Workload in Hours Jointudes Students can Jointudes Jointudes Jointudes Jointudes Jointudes Jointudes Jointudes Jointude Jo		Mechanics I/II					
Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Skills After successful completion of this module, the students can express the basic aspects of linear frame analysis of static indeterminate systems. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence linear statically inderminate plane and spatial frame and truss structures. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence linear statically inderminate plane and spatial frame and truss structures. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence linear statically inderminate plane and spatial frame and truss structures. Personal Competence Students can Social Competence Students can I - uptrifighter in subject-specific and interdisciplinary discussions, - defend their own work routis fingt momenerix assignments. Due to the in-term feedback, they are enabled to self-assess II learning progress during the lecture period, already. Exomination Independent Study Time 124, Study Time in Lecture 55 Course achievement Iongendent Study inter elaboration - Hausibungen mit Testat, betreat durch Studentsche Tutore	Knowledge	Mathematics I/II					
Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Skills After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inferminate plane and spatial frame and truss structures. Personal Competence Students can Social Compotence Students can Social Compotence Students can • participate in subject-specific and interdisciplinary discussions, • defend their own work results in front of others • participate in subject-specific and interdisciplinary discussions, • defend their own work results in front of colleagues • Furthermore, they can give and accept professional constructive criticism Automory The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the learning progress during the lecture period, already. Workload In Hours Independent Study Time 124, Study Time in Lecture 56 Course achievent General Engineering Schuce (German program, 7 Senester): Specialisation Civil Engineering: Computary Feese Team Assignment for the General Engineering Schuce (German program, 7 Senester): Specialisation Civil Engineering: Computary Feese Team Course achievent Geneal Engineering: Core Qualification: Compulsary		 Differential Equation 	s I				
Professional Competence After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Skill After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Personal Competence Students can Social Competence Students can • carticipate in subject-specific and interdisciplinary discussions, • defend their own work results in fort of others • promote the scientific development of colleagues • promote the scientific development of colleagues • furthermore, they can give and accept professional constructive criticism Autonomy The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the learning progress during the lecture period, already. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement Compatienty Boow Term Description No 10 % Written elaboration Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium) Examination durits Conputery Boow Term Description No 10 % Written elaboration Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium) Examination durits Conputering S		 Structural Analysis I 					
Professional Competence After successful completion of this module, students can express the basic aspects of linear frame analysis of static indeterminate systems. Skill After successful completion of this module, the students are able to analyze state variables and to construct influence lines statically inderminate plane and spatial frame and truss structures. Personal Competence Students can Social Competence Students can • carticipate in subject-specific and interdisciplinary discussions, • defend their own work results in fort of others • promote the scientific development of colleagues • promote the scientific development of colleagues • furthermore, they can give and accept professional constructive criticism Autonomy The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the learning progress during the lecture period, already. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement Compatienty Boow Term Description No 10 % Written elaboration Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium) Examination durits Conputery Boow Term Description No 10 % Written elaboration Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium) Examination durits Conputering S							
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Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Bastian Oesterle Language DE							
Lecturer Prof. Bastian Oesterle Language DE							
Language DE			, Study Time in Lect	ture 28			

Cycle	Sose
Content	 Analysis of statically indeterminant structures Force method, displacement method coputational methods, direct stiffness method elastically supported structures
Literature	 Vorlesungsmanuskript Bletzinger et al.: Aufgabensammlung zur Baustatik: Übungsaufgaben zur Berechnung ebener Stabtragwerke. Hanser. Dinkler: Grundlagen der Baustatik. Springer. Marti: Baustatik. Ernst und Sohn.

Course L0674: Structural Ana	urse 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. Bastian Oesterle				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Courses				
Title		Тур	Hrs/wk	СР
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	. Church and a church l. Church and a church			
Knowledge	Structural analysis I, Structural analysis I	I		
	Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	 Principles of Building Materials and Build 	ing Physics		
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	After passing this module students are able to			
	 give a summary of the security concept 			
	explain the priciples of the design process	s		
	 describe and illustrate the bhaviour of m 	emers in tension, compression and bending		
Skills	Students can rate and apply the material steel	appropiately with respect to its properties and	l usage.	
	They can use the security concept with respect	to loads, forces and resistances.		
	They can check the ultimate limit state and the	serviceability of simple members in tension, o	compression and	bending.
Personal Competence				
Social Competence	After participation of an optional course (buildi	ng of a simple truss) they are able to organiz	ze themselves in	groups. They will be
	successful in guided building a truss with bolted	connections according to design drawings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Civil Engineering	: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Core Qua	lification: Compulsory		
Course L0299: Steel Structu				
	Lecture			
Hrs/wk	2			

71				
Hrs/wk	2			
CP				
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Marcus Rutner			
Language	DE			
Cycle	WiSe			
Content	 Introduction to steel constructions Materials Design and security model Tension rods Beams (elsatic and plastic design Column design Bolted connections 			
	Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 • Band 1 Tragwerksplanung, Grundlagen • Band 2 Verbindungen und Konstruktionen			

Course L0300: Steel Structur	Course L0300: Steel Structures I		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Marcus Rutner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses							
Title					Тур	Hrs/wk	СР
Hydrology (L0909)					Lecture	1	1
Hydrology (L0956)					Project-/problem-based Learning	1	2
Hydromechanics (L0615)					Lecture	2	2
Hydromechanics (L0616)					Project-/problem-based Learning	1	1
Module Responsible	Prof. Peter	Fröhle					
Admission Requirements							
Recommended Previous	Mathemati	cs I, II and	1 111				
Knowledge	Mechanics	l und ll					
Educational Objectives	After taking	g part suc	cessfully, students have re	eached the followin	ig learning results		
Professional Competence							
Knowledge	They are a and quanti	ble to der ify the re -off-mode	ive the basic formulations levant processes of the l	s of i) hydrostatics, hydrological water	nics, hydrology groundwater h ii) kinematics of flows and iii) cycle. Besides, the students of models as well as the concep	conservation can describe	laws and to descri the main aspects
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, they a able to run, explain and document basic hydraulic experiments. Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students ha						
	In addition,	, the basic		ements of hydrolog	els and a unit-hydrograph to giv gical and hydrodynamic values o rs.		bed and the stude
Personal Competence							
Social Competence		ssions by	use of peer learning appr		structured manner. They can e are, they are able to prepare ar		
Autonomy	specific kn	owledge.		ther with feedback	ontribute to the conduct of exp and suggestions on their resu is.		
Workload in Hours	Independer	nt Study T	ime 110, Study Time in Le	ecture 70			
Credit points							
Course achievement	Compulsory Yes Yes Yes	Bonus None None None	Form Group discussion Excercises Subject theoretical practical work	Hydrologie in Übungsaufgat andDurchführung	ne Posters zu einer Themat Gruppen und Präsentation pen Hydrologie , Dokumentation und Präs ik oder Hydraulik in Gruppen		-
Examination	Written exa	am					
Examination duration and							
scale Assignment for the Following Curricula			Science (German progran ntal Engineering: Core Qu		ecialisation Civil Engineering: Co sory	mpulsory	
	5		y: Specialisation Traffic Pla nagement - Major in Logist	5 ,	s: Elective Compulsory pecialisation Traffic Planning and	d Systems: El	ective Compulsory

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 and groundwater hydrology: Hydrological cycle Data acquisition in hydrology Data analyses and statistical assessment Statistics of extremes Regionalization methods for hydrological values rainfall-run-off modelling on the basis of a unit hydrograph concept
Literature	Maniak, U. (2017). Hydrologie und Wasserwirtschaft: Eine Einführung für Ingenieure. Springer Vieweg. Skript "Hydrologie und Gewässerkunde"

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

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

Course L0616: Hydromechan	urse L0616: Hydromechanics		
Тур	Project-/problem-based Learning		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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						
Admission Requirements						
Recommended Previous	Modules :					
Knowledge	Mechanics I-	-11				
Educational Objectives	After taking part su	accessfully, students	s have reached the follow	ving learning results		
Professional Competence						
Knowledge				e and characteristics of soil, s		5
	or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure.					
Skills	After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate					
	them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight					
	influence of structu	ires. They are are al	ble to prove the usability	(settlements) for shallow four	ndations.	
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study	Time 96, Study Tim	ne in Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 20%	Attestation				
Examination	Written exam					
Examination duration and	90 minutes					
scale						
Assignment for the	General Engineerin	ig Science (German	program, 7 semester): S	pecialisation Civil Engineering	: Compulsory	
Following Curricula	Civil- and Environm	nental Engineering:	Core Qualification: Comp	oulsory		
	Logistics and Mobil	ity: Specialisation T	raffic Planning and Syste	ms: Elective Compulsory		
	Technomathematic	s: Specialisation III.	Engineering Science: Ele	ective Compulsory		

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

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

Course L1493: Soil Mechanic	:5
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Courses					
Title	Ту	p	Hrs/wk	СР	
Basics in Structural Design (L0209)		pject-/problem-based Learning	2	4	
Basics of Structural Design (L0205)		cture	2	1	
Basics in Structural Design (L0208)	Rea	citation Section (large)	1	1	
Module Responsible					
Admission Requirements	None				
Recommended Previous	Contents of module "Principles of Building Materials and Building Phy	ysics"			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following le	earning results			
Professional Competence					
Knowledge	After attending the "Building Construction" module students are able	e			
	 to define the basics of building regulations law 				
	 to explain load effects and associated concepts 				
	 to describe overriding conventions of the construction industr 	V			
	 to specify typical building components 				
	 to distinguish between different possibilities of load bearing b 	ehaviour and risks due to lac	k of stability		
	 to explain the main objective of fire control. 		· · · · ,		
Skills	After the successful completion of the "Building Construction" module, students will be able				
	 to apply industry-specific drawing conventions 				
	carry out preliminary dimensioning of basic building components				
 carry out preliminary dimensioning of basic building components develop stability and foundation concepts 					
	 use BIM software and to design and construct standard cross-sections due to structural aspects. 				
		ructural aspects.			
Personal Competence					
Social Competence	After attending the course students are able				
	 to work in a team and to persent the results of the team work 	(
	 to use the feedback from other students to improve the own r 				
	• to give a feedback to other students in a constructive manner				
A L = .	After attending the course students are at t				
Autonomy	After attending the course students are able				
	 to control and improve their knowledge with the help of weee 	kly presentations (lecture roc	om) and tests	(STUD.IP)	
	 to divide the main task in different parts, to deduce the needed 	ed knowledge and to schedule	e the different	t work steps	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Desing, Construction and prelimnary design in a written form				
scale					
Assignment for the	General Engineering Science (German program, 7 semester): Specia	lisation Civil Engineering: Co	mpulsory		
Following Curricula	Civil- and Environmental Engineering: Core Qualification: Compulsor	у			
	Integrated Building Technology: Core Qualification: Compulsory				

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

Course L0205: Basics of Stru	ctural Design			
Тур				
Hrs/wk				
CP				
	Independent Study Time 2, Study Time in Lecture 28			
	Sebastian Rybczynski			
Language				
Cycle	WiSe			
Content	Basics of building regulation laws			
	Foundation of buildings			
	Sealing of basements			
	• facades			
	Ceilings			
	Roofs			
	Windows, doors and post-and-beam constructions			
	Staircases			
	Basics of strucural engineering design			
	Structural fire prevention			
	Optional tests on STUD.IP			
Literature	Vortragsfolien der Lehrveranstaltung stehen über STUD. IP zum download zur Verfügung			
	Schneider Bautabellen (Hrsg. A. Albert)			
	23., überarbeitete Aufl.			
	ISBN 978-3-8462-0880-9			
	Reguvis Fachmedien GmbH, 2018			
	Neumann, Dietrich (Hestermann, U.; Rongen, L.; Weinbrenner, U.) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource]			
	ISBN: 978-3-8351-9121-1			
	Wiesbaden: Vieweg+Teubner Verlag, 2006			
	Wiesbauen, vieweg+reubrier verlag, 2000			
	Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.)			
	Baukonstruktionslehre 2 / [Internet-Ressource]			
	ISBN: 978-3-8348-9486-1			
	Wiesbaden: Vieweg+Teubner Verlag, 2008			
	Dierks, Klaus (Wormuth, R.)			
	Baukonstruktion			
	ISBN: 978-3-8041-5045-4			
	Neuwied : Werner, 2007			
	Neufert, Ernst (Kister, J.)			
	Bauentwurfslehre (42. Aufl.)			
	ISBN: 978-3-8348-0732-8			
	Wiesbaden : Vieweg + Teubner, 2018			
	Wendehorst, Reinhard (Wetzell, O. W.,; Baumgartner, H.,)			
	Wendehorst, Keinnard (Weizell, O. W.,; Baufigartier, H.,) Wendehorst Bautechnische Zahlentafeln			
	ISBN: 978-3-8351-0055-8			
	Stuttgart/Berlin: Teubner/Beuth, 2018			

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

Module M0631: Reinf	orced Concrete Structur	es II			
Courses					
Title			Тур	Hrs/wk	СР
Project Concrete Structures II (L089	94)		Project Seminar	1	1
Concrete Structures II (L0348)			Lecture	2	3
Concrete Structures II (L0349)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach				
Admission Requirements	None				
Recommended Previous	 Knowledge of loads on struc 	tures and combination of acti	0.00		
Knowledge	-		0115		
	 Basics of safety format are r Knowledge in design of bear 		imit stata		
	 Modules: Reinforced Concre 	le Structures I, Structural And	ilysis i+ii, mechanics i+ii		
Educational Objectives	After taking part successfully, stud	ents have reached the follow	ing learning results		
Professional Competence					
Knowledge	The students know the basic prin	ciples which are required for	design of reinforced concre	te structures. Th	ey know the various
	methods to estimate the member forces in simple one and two-way slabs.				
Skills	• The students can design r	• The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in th			
	-	ick and deflection control) inc		-	torsion, and in the
	•			ind links etc.).	
	The students can estimate the member forces of simple slabs.The students know the content and the layout of a structural analysis				
	• The students know the cond	ent and the layout of a struct			
Personal Competence					
Social Competence	Cooperation in a project work, whe	re they design in a team a re	al concrete building and pres	ent the results at	the end.
Autonomy					
Workload in Hours	Independent Study Time 110, Stud	ly Time in Lecture 70			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No None Excercises				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	General Engineering Science (Gern	nan program, 7 semester): Sp	ecialisation Civil Engineering	: Elective Compu	lsory
Following Curricula	Civil- and Environmental Engineeri	ng: Specialisation Civil Engine	ering: Compulsory		
	Civil- and Environmental Engineeri	ng: Specialisation Traffic and	Mobility: Elective Compulsory	/	
	Civil- and Environmental Engineeri	ng: Specialisation Water and	Environment: Elective Compu	Ilsory	
Course L0894: Project Concr	ete Structures II				

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

Course L0348: Concrete Stru	ctures II
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 Design of concrete members for shear, punching and torsion Design for serviceability limit state (durability): crack- and deflection control Detailing Design of discontinuity regions (e.g. corbels, frame corner) design of footings Introduction in the design of slabs Layout and content of a structural design
Literature	 Vorlesungsumdrucke zum downloaden im STUDiP Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998 Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011 Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 Grasser E. ,Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978 DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 1: Allgemeine Bemessungsregeln für den Hochbau.

Course L0349: Concrete Stru	ourse L0349: Concrete Structures II		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1634: Comp	utational Structural Mechan	ics		
Courses				
Title		Тур	Hrs/wk	СР
Computational Stuctural Mechanics	s (L2475)	Integrated Lecture	2	2
Computational Structural Mechanic	s (Exercise) (L2873)	Recitation Section (small)	1	1
Module Responsible	Prof. Christian Cyron			
Admission Requirements	None			
Recommended Previous	Engineering Mechanics I, Engineering Me	chanics II, Mathematics I, Mathematics II		
Knowledge				
Educational Objectives	After taking part successfully, students have	ave reached the following learning results		
Professional Competence				
Skills	importance of computational methods in modern solid mechanics and in particular also the theoretical foundations of the finit element method. Students are able to develop simple computational methods and programs to solve problems in solid mechanics. Moreove student have sufficient basic knowledge about the finite element method to use commercial software in this area for th successful solution of at least simple problems (after a short introduction into the handling of a specific software package)			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 48, Study Time	in Lecture 42		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Civil Engineering	3: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Sp	ecialisation Civil Engineering: Compulsory		

Course L2475: Computationa	al Stuctural Mechanics			
	Integrated Lecture			
Hrs/wk				
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Christian Cyron			
Language	DE			
Cycle	SoSe			
Content	The lecture Computational Structural Mechanics extends the content of the lecture Engineering Mechanic II. It bridges the gap			
	between the manual calculation of mechanical stress and deformation in systems with a particularly simple geometry and the			
	cent computer-based computation of general mechanical systems:			
	Basics of linear continuum mechanics			
	Planar structures: plate, membrane, slab			
	Linientragwerke: beam, cable, truss			
	Weak form and Galerkin's method			
	Finite element method: theory and application			
	Principles of mechanics: principle of virtual work, virtual displacements, virtual forces			
Literature	Gross, Hauger, Wriggers, "Technische Mechanik 4", Springer			

Course L2873: Computationa	Course L2873: Computational Structural Mechanics (Exercise)				
Тур	Recitation Section (small)				
Hrs/wk	1				
CP	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Christian Cyron				
Language	DE				
Cycle	SoSe				
Content	The exercise on Computational Structural Mechanics demonstrates how the theoretical content of the lecture on Computational				
	Structural Mechanics can be applied to solve specific mechanical problems.				
Literature					

Module M1629: Geoir	formation Science				
Courses					
Title		Тур	Hrs/wk	СР	
Introduction to Geoinformation Scie	ence (L2465)	Project-/problem-based Learnin	ig 3	3	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Principles of analysis and linear algebra				
Knowledge					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence					
Knowledge	The students are able to define the tasks and terms from the field of application of geo information systems. They can report the				
	basics, the basic approaches and methods of geo information systems and are able to transfer these to practical questions.				
Skille	Students are able to apply the basic meth	nods used in geo-information systems to practical pr	oblems. They a	re able to apply the	
JKIIIS			-		
	to simple applications of geographic information systems and to transfer them to other problems. The students can process a simple GIS project and present their results.				
Personal Competence					
Social Competence	The students can work together groups co	ooperatively and productively.			
Autonomy	Students are able to organize their wor	k flow to prepare themselves before presentation	s and discussio	on They can acqui	
hatehenny	appropriate knowledge by making enguiring		s and alseassie	in they can acqui	
		······································			
Workload in Hours	Independent Study Time 48, Study Time in	n Lecture 42			
Credit points	3				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Computer aided GIS-Application and writte	en-theoretical part			
scale					
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Civil Engineering:	Compulsory		
Following Curricula	Civil- and Environmental Engineering: Spe	ecialisation Traffic and Mobility: Compulsory			
	Civil- and Environmental Engineering: Spe	ecialisation Water and Environment: Compulsory			

Course L2465: Introduction t	to Geoinformation Science
Тур	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Yohannis Tadesse
Language	DE
Cycle	SoSe
Content	 Theoretical basics of Geo-Information-Systems Data models, geographical coordinates, geo-referencing, map-views Data mining and -analyses of geo-data Analysis techniques
Literature	

Module M0612: Steel	Structures II			
Courses				
Title		Тур	Hrs/wk	СР
Steel Structures II (L0301)		Lecture	2	3
Steel Structures II (L0302)	Γ	Recitation Section (large)	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Steel Structures I			
Knowledge				
Educational Objectives	After taking part successfully, students I	nave reached the following learning results		
Professional Competence				
Knowledge	After successful completition students ca	an		
	 describe and explain the behavior 	ir of holted and wolded connections		
	 design and check simple halls and 			
	÷ ,	mple structures (trusses, beams, frames)		
		details (framework, column base, load application	noints)	
			points)	
Skills	Students are able to design simple struc	tures and connections, describe the load distribut	tion and recognize t	he possible modes
	failure. They can apply structural imperf	ections, calculate according to 2nd order theory a	nd verify their result	ts.
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Civil Engineeri	ing: Elective Compu	lsory
Following Curricula	Civil- and Environmental Engineering: Sp	pecialisation Civil Engineering: Compulsory		
	Civil- and Environmental Engineering: Sp	pecialisation Traffic and Mobility: Elective Compuls	ory	
	Civil- and Environmental Engineering: Sp	pecialisation Water and Environment: Elective Com	pulsory	

Course L0301: Steel Structur	res II
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	SoSe
Content	 Welded connections Simple constructions Trusses Plate girders Frames Columns Buildings with several storeys Halls
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 L0302: Steel Structur	Course L0302: Steel Structures II	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0755: Geote	echnics II			
Courses				
Fitle		Тур	Hrs/wk	CP
Foundation Engineering (L0552)		Lecture	2	2
Foundation Engineering (L0553)		Recitation Sect		2
Foundation Engineering (L1494)		Recitation Sect		2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules:			
Knowledge				
-	 Mechanics I-II 			
	Geotechnics I			
Educational Objectives	After taking part successfully, student	s have reached the following learning res	ults	
Professional Competence				
Knowledge	The students know the basic principles and methods which are required to verificate the stability of geotechnical structures.			
-	s After successful completion of the module the students are able to:			
	 verificate the stability and usab 	ility of foundations,		
	 know individual methods of gro 	und improvement and apply them in thei	r range of application,	
	design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Tir	ne in Lecture 84		
Credit points		Description		
Course achievement	No 20 % Attestation	Description		
Examination	Written exam			
Examination duration and scale				
		program 7 comostor), Crossializzation Ci	il Casinessing, Flashive Course	deem
-		program, 7 semester): Specialisation Civ		usory
Following Curricula	5 5	Specialisation Civil Engineering: Compuls	•	
		Specialisation Traffic and Mobility: Electiv		
		Specialisation Water and Environment: E		
	Technomathematics: Specialisation III	. Engineering Science: Elective Compulso	ry	

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

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

Course L1494: Foundation E	urse 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/SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Specialization Chemical and Bioengineering

Courses			
fitle		Тур	Hrs/wk CP
ntroduction to Chemical and Bioen	-	Lecture	2 3
Module Responsible	-		
Admission Requirements	None		
Recommended Previous			
Knowledge			
-	After taking part successfully, studer	ts have reached the following learning results	
Professional Competence			
Knowledge			
Skills			
Personal Competence			
Social Competence			
Autonomy			
Workload in Hours	Independent Study Time 62, Study T	ime in Lecture 28	
Credit points	3		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	max. 5 pages		
scale			
Assignment for the	General Engineering Science (Germa	n program, 7 semester): Specialisation Chemical and	Bioengineering: Compulsory
Following Curricula	Chemical and Bioprocess Engineering	g: Core Qualification: Compulsory	

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dozenten des SD V
Language	DE
Cycle	WiSe
Content	
Literature	

C					
Courses					
Title Practical Course Measurement Technology (L2270)			Typ Practical Course	Hrs/wk	CP 2
Measurement Technology (L2268)	IIII0I0gy (L2270)		Lecture	2	2
Physical Fundamentals of Measure	ment Technology (L22	69)	Lecture	2	2
Module Responsible					
Admission Requirements	None				
Recommended Previous		logical skills, integral-	and differential calculus, basic physical cond	cepts such as tempera	ature, mass, veloci
Knowledge					,
Educational Objectives	After taking part su	iccessfully, students ha	ave reached the following learning results		
Professional Competence					
Knowledge	Physical basics: ki	inematics and dynam	ics (theory of motion), rotation of rigid be	odies, energy and m	omentum, electric
	magnetism, basics	of hydrodynamics, ten	nperature and heat, ideal gas.		
	Metrology: SI units	. measurement and m	neasurement uncertainty, basics of sensor te	chnology, physical pr	inciples, temperat
			vel measurement, flow measurement. Usage		
	Practical course: Pressure drop in piping, calorimetry, image data acquisition, flow measurement, concentration measurement and				
	mass transfer, capa	acitive measurements	of solid concentrations, spectroscopy, error ca	lculation, chromatogra	aphy
Skills	Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, fir				
	programming with Matlab, use of relevant laboratory measurement technology, preparation of a test protocol, execution				
	calculations.				
Personal Competence					
Social Competence	-		ctical training and learning groups, assessme		-
	experimental stand in groups, consultation with persons responsible for teaching, presentation of the preparation of the				
	experiment, tolerar	nce of frustration			
Autonomy	Time management of the workload, independent development of the thematic basics, personal responsibility for the provision o				
	protective equipment and work clothing, practice of presentation in front of a group, active participation in the lecture				
	formulation of enquiries/detailed questions by using clicker.				
Workload in Hours		Time 96, Study Time i	n Lecture 84		
Credit points	6 Compulsory Bonus	Form	Description		
Course achievement	No 20 %	Excercises	Popup-Quizzes währen der Vorlesur	a	
Examination	Written exam			- 5	
Examination duration and					
scale	120 11111				
	General Engineerin	a Science (German pr	ogram, 7 semester): Specialisation Process En	aineering: Compulsory	,
	-				
ronowing curricula	General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory				
	Bioprocess Engineering: Core Qualification: Compulsory				
	Chemical and Bioprocess Engineering: Core Qualification: Compulsory				
		5 5	ate: Core Qualification: Compulsory		
		: Core Qualification: El			

Course L2270: Practical Cour	rse Measurement Technology
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Penn
Language	DE
Cycle	WiSe
	In the Practical Course in Measurement Technology the theory from the lectures "Physical Fundamentals of Measurement Technology" and "Measurement Technology" will be applied in practice. In small groups students learn how to handle different measurement techniques from industry and research. During the practical course, a wide range of different measurement methods will be taught, including the use of HLPC columns for qualitative mass analysis, the determination of mass transfer coefficients using optical oxygen sensors or the evaluation of image data to obtain process parameters. The practical course also teaches how measurement data are statistically evaluated and experiments are correctly documented.
Literature	Hug, H.: Instrumentelle Analytik. Theorie und Praxis. Verlag Europa-Lehrmittel, Haan-Gruiten, 2015. Kamke, W.: Der Umgang mit experimentellen Daten, insbesondere Fehleranalyse, im physikalischen Anfänger-Praktikum. Eine elementare Einführung. W. Kamke, Kirchzarten [Keltenring 197], 2010. Strohrmann, G.: Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. Oldenbourg, München, 2004.

Course L2268: Measurement	Technology
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Penn
Language	DE
Cycle	WiSe
Content	Basic introduction to measurement technology for process engineers. Includes error calculation, measurement units, calibration, measurement data analysis, measurement techniques and sensors. Particular attention is paid to the measurement of temperature, pressure, flow and level. The lecture provides insights into the latest developments in sensor technology in measurement technology and process engineering.
Literature	 Fraden, Jacob (2016): Handbook of Modern Sensors. Physics, Designs, and Applications. 5th ed. 2016. Cham, New York: Springer. Online verfügbar unter http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&AN=1081958. Hering, Ekbert; Schönfelder, Gert (2018): Sensoren in Wissenschaft und Technik. Funktionsweise und Einsatzgebiete. 2. Aufl. 2018. Online verfügbar unter http://dx.doi.org/10.1007/978-3-658-12562-2. Strohrmann, Günther (2004): Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. 10., durchges. Aufl. München: Oldenbourg. Tränkler, Hans-Rolf; Reindl, Leonhard M. (2014): Sensortechnik. Handbuch für Praxis und Wissenschaft. 2., völlig neu bearb. Aufl. Berlin: Springer Vieweg (VDI-Buch). Online verfügbar unter http://dx.doi.org/10.1007/978-3-642-29942-1. Webster, John G.; Eren, Halit B. (2014): Measurement, Instrumentation, and Sensors Handbook, Second Edition. Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement. 2nd ed. Hoboken: Taylor and Francis. Online verfügbar unter http://gbv.eblib.com/patron/FullRecord.aspx?p=1407945.

Course L2269: Physical Fundamentals of Measurement Technology				
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Christian Schroer			
Language	DE			
Cycle	WiSe			
Content	Classical mechanics - kinematics, dynamics, energy, momentum and conservation laws, rigid bodies, translation and rotation, angular momentum. Mechanics of gases and fluids - hydrostatics and hydrodynamics Thermodynamics - temperature, heat, heat transport, ideal gas, changes of state, cyclic processes, laws of thermodynamics Electricity - electrostatics, electrical conduction, magnetism, Lorentz force, Maxwell's equations (integral form)			
Literature	Paul A. Tipler, Gene Mosca: Physik für Wissenschaftler und Ingenieure, Spektrum Verlag D. Meschede (Hrsg.): Gerthsen Physik, Springer-Verlag Jay Orear: Physik, Hanser Verlag D. Halliday, R. Resnick, J. Walker: Physik, Wiley VCH			

Courses						
Title			Тур		Hrs/wk	СР
Biological and Biochemical Fundamentals (L2900)			Lecture		2	2
Fundamental Biological and Biochemical Practical Course (L2901) Introduction to the Biological and Biochemical Practical Course (L2902)			Practical Course	urse	3	3
			Lecture		1	1
	Prof. Johannes Gesche	ſ				
	None The module is divided into two parts. In the winter semester, a lecture with 2 semester hours per week is offered. No p					
Knowledge	knowledge is required for this lecture. In the following summer semester, the second part of the module is offered. This is divide into an internship and an introductory lecture. For these two parts of the module, attendance of the lecture in the winter semest is strongly recommended.					
Educational Objectives	After taking part succe	essfully, students have	reached the following learning r	results		
Professional Competence						
knowieage	The module aims to teach you the basic principles of biological systems and biocatalysts. You will learn how organisms a constructed and what basic characteristics can be used to distinguish organisms from the three kingdoms of life. You will lear about the ways in which biological systems can produce energy and you will apply the principles of biological thermodynamics. addition, you will learn how enzymes are constructed and, using some classes of enzymes as examples, you will learn how enzymes exert their effect.					
	At the end of the module					
	- you will be able to describe basic principles of living systems and explain the metabolism of organisms by applying them.					
	- you will be able to assign organisms to the three kingdoms of life based on some basic characteristics					
	- you will be able to describe the tasks of enzymes generically on the basis of some example reactions					
	 you will be able to deduce from the basic characteristics of organisms and enzymes which biotechnological applications ar possible with these systems. 					
	- you can understand and use the technical vocabulary of biological systems and processes					
	- you will be able to perform simple bioinformatic operations to assign DNA sequences to a function					
	- you can confidently apply the basic principles of using primary literature					
Skills	The students master the basic techniques of sterile work and molecular diagnostics. They can independently prepare media maintain microorganisms in culture. In addition, they can isolate and characterize organisms from enrichment cultures environmental samples.					
Personal Competence						
Social Competence	The students are able,	,				
	- to gather knowledge in groups of about 2 to 10 students					
	- to introduce their own knowledge and to argue their view in discussions in teams					
	- to divide a complex task into subtasks, solve these and to present the combined results					
Autonomy	Students are able to independently structure their internship days and prioritize tasks. Furthermore, they are able to collect a process basic information on microorganisms via a literature search.					
Workload in Hours	Independent Study Tir	me 96, Study Time in L	ecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description	waahaig!	Due labila una -	
Examination	Yes None Written exam	Presentation	Zusammenstellung der E	i yebnisse dês	FIGKUKUIIIS	
Examination Examination duration and						
scale	50 mm					
Assignment for the	General Engineering S	cience (German progr	am. 7 semester): Specialisation (Chemical and	Bioengineering: Con	npulsorv
-	General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory					

Course L2900: Biological and	l Biochemical Fundamentals
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Johannes Gescher
Language	DE
Cycle	WiSe
Content	In the lecture we will learn the basic characteristics of organisms of all kingdoms of life. This includes cell biology as well as cell physiology. We understand the energetic foundations of living systems and the variety of possible metabolic concepts of life. From these basic laws we will understand how and to what extent an application and genetic reprogramming of organisms for application can take place.
Literature	Fuchs: Allgemeine Mikrobiologie, 11. vollständig überarbeitete Auflage 2022; ISBN: 9783132434776 Brock: Biology of Microorganisms, ISBN-13: 9780134626109

Course L2901: Fundamental	Biological and Biochemical Practical Course
Тур	Practical Course
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Johannes Gescher
Language	DE
Cycle	SoSe
Content	The aim of the practical course is to teach basic microbiological and molecular biological techniques on the basis of individual research assignments and control experiments. In doing so, organisms are to be isolated in this practical course, which will be further processed by students of the 4th and 6th semester in two independent modules.
Literature	Steinbüchel: Mikrobiologisches Praktikum, ISBN: 978-3-662-63234-5

Course L2902: Introduction t	o the Biological and Biochemical Practical Course
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Johannes Gescher
Language	DE
Cycle	SoSe
	The aim of the introductory lecture is to explain different methods used and their range of application. In addition, we will clarify specific physiological characteristics of the microorganisms to be isolated.
Literature	Steinbüchel: Mikrobiologisches Praktikum, ISBN: 978-3-662-63234-5

Courses							
Title				Тур	Hrs/wk	СР	
Fundamentals of Fluid Mechanics (L0091)				Lecture	2	2	
Fundamentals on Fluid Mechanics (Recitation Section (small)	2	2	
Fluid Mechanics for Process Engineering (L0092)				Recitation Section (large)	2	2	
Module Responsible	Prof. Michael Schlüter						
Admission Requirements	None						
Recommended Previous	Mathematics I+	.11.1.111					
Knowledge							
	Technical Mechanics I+II Technical Thermodynamics I+II						
	Technical Thermodynamics I+II Working with force balances						
		nd solving of partial diff	forontial oquations				
		nu solving of partial un					
	Integration						
Educational Objectives	After taking part succe	essfully, students have	reached the following	ng learning results			
Professional Competence							
Knowledge	Students are able to:						
	 explain the difference 	erence between differer	nt types of flow				
				s Transport-Theorem in proce	ss enaineerina		
 give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions 					ons		
				, , , , , , ,			
Skills	The students are able	to					
	describe and model incompressible flows mathematically						
	 reduce the government 	erning equations of fluid	d mechanics by sim	plifications to archive quantil	ative solutions e.	g. by integration	
	 notice the dependence 	endency between theory	and technical appl	lications			
	 use the learned basics for fluid dynamical applications in fields of process engineering 						
Personal Competence							
Social Competence	The students						
boelar competence							
			n subject related, p	rofessional publications and	relate that inform	nation to the conte	
	of the lecture a					<i></i>	
			ed tasks in small g	roups. They are able to pres	ent their results	effectively in Engli	
		all group exercises)		to discuss the colutions are	lly and to present	the reculte	
	 are able to work 	k out solutions for exerc	cises by themselves	s, to discuss the solutions ora	lly and to present	the results.	
Autonomy	The students are able	to					
	• coarch further l	itoratura far aach tanic	and to expand their	r knowledge with this literatu	10		
				r knowledge with this literatu actual knowledge with the fe			
	• Work on their e.	xercises by their own a	la to evaluate their	actual knowledge with the R	euback.		
Workload in Hours	Independent Study Tir	me 96, Study Time in Le	ecture 84				
Credit points							
Course achievement	Compulsory Bonus	Form	Description				
Factor 10 - 41	No 5 %	Midterm					
Examination							
Examination duration and scale	3 nours						
	General Engineering S	cience (German progra	m 7 semester): Sn	ecialisation Green Technolog	ies: Compulsory		
Following Curricula						npulsory	
. Showing curricula	General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory						
	Chemical and Bioprocess Engineering: Core Qualification: Compulsory						
	Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory						
		chnology: Core Qualific					
	5 5	57		ns: Elective Compulsory			
	- ,	Specialisation III. Engine					
		Core Qualification: Com	-	ave compusory			
		core guanneauon, com					

Course L0091: Fundamentals	of Fluid Mechanics
Тур	Lecture
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	 fluid properties hydrostatic overall balances - theory of streamline overall balances - conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Falg / 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 L2933: Fundamentals	s on Fluid Mechanics
Тур	Recitation Section (small)
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 group exercise, the contents of the lecture are taken up and deepened by means of exercises. The exercise tasks correspond in quality and scope to the tasks of the written exam. Topics: Reynolds transport-theorem, pipe flow, free jet, angular momentum, Navier-Stokes equations, potential theory, mock exam, pipe hydraulics, pump design.
Literature	Heinz Herwig: Strömungsmechanik, Eine Einführung in die Physik und die mathematische Modellierung von Strömungen, Springer Verlag, Berlin, 978-3-540-32441-6 (ISBN) Herbert Oertel, Martin Böhle, Thomas Reviol: Strömungsmechanik für Ingenieure und Naturwissenschaftler, Springer Verlag, Berlin, ISBN: 978-3-658-07786-0 Joseph Spurk, Nuri Aksel: Strömungslehre, Einführung in die Theorie der Strömungen, Springer Verlag, Berlin, ISBN: 978-3-642- 13143-1.

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

Courses					
Title Phase Equilibria Thermodynamics (10114)	Typ Lecture	Hrs/wk 2	CP 2	
Phase Equilibria Thermodynamics (Recitation Section (small)	1	2	
Phase Equilibria Thermodynamics (Recitation Section (large)	1	2	
Module Responsible	Prof. Irina Smirnova				
Admission Requirements	None				
Recommended Previous	Mathematics, Physical Chemistry, Thermodynamics I	and II			
Knowledge					
	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	 Starting from the very basics of thermodyna 	mics, the students learn the mathemati	cal tools to desc	ribe thermodyna	
	equilibria.				
	They learn how state variables are influenced	d by the mixing of compounds and lear	n concepts to qu	antitatively descr	
	these properties.				
	 Moreover, the students learn how phase equ 	ilibria can be described mathematically	and which phen	iomena may occu	
	different phases (vapor, liquid, solid) coexist ir				
	 For different phase equilibria, several example 		esses are shown	n and the necess	
	knowledge for plotting and interpreting the eq	uilibria are taught.			
CL:III-					
Skills	 Applying their knowledge, the students are a 	able to identify the correct equation for	the determination	on of the equilibri	
	state and know how to simplify these equations meaningfully.				
	 The students know models which can be used 	d to determine the properties of the syst	em in the equili	orium state and th	
	are able to solve the resulting mathematical re	elations.			
	 For specific applications, they are able to self- 	-reliantly find necessary physico-chemica	I properties of c	ompounds as well	
	model parameters in literature sources.		e		
	 Beside pure compound properties the student: The students know how to visualize phase any 			urring phonomon	
		 The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomer Based on their knowledge, the students are able to understand fundamental concepts that are the basis for n 			
	separation and reaction processes in chemical		icepts that are		
	separation and reaction processes in chemical	engineering.			
Personal Competence					
Social Competence	The students are able to work in small groups, to so	olve the corresponding problems and to	present them or	aly to the tutors a	
	other students				
Autonomy	The students are able to find necessary inform	ation colf voliantly in literature courses o	nd to judeo thoir	au alibu	
	 The students are able to find necessary morn During the semester the students are able 	,	, 5	1 3	
	knowledge the students can adept their learni		nuousiy in exer	cises. Dased off	
	knowledge the students can ddept their rearm				
Mauldan d. Iv. 11-	Independent Study Time 104, Study Time in Las	EC			
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture	00			
Course achievement					
Examination					
	120 minutes; theoretical questions and calculations				
scale					
	General Engineering Science (German program, 7 se	mester): Specialisation Green Technologi	es. Focus Renew	able Energy: Flee	
Following Curricula				Life Life gyr Life	
	General Engineering Science (German program, 7 se	mester): Specialisation Chemical and Bio	engineering: Cor	npulsory	
	Bioprocess Engineering: Core Qualification: Compulse		5 5 5 5 5		
	Chemical and Bioprocess Engineering: Core Qualifica	•			
	Green Technologies: Energy, Water, Climate: Special		Compulsory		
	Green Technologies: Energy, Water, Climate: Special				
	Process Engineering: Core Qualification: Compulsory				

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

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

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

Courses					
Fitle		Тур	Hrs/wk CP		
Genetics and Molecular Biology (L0	889)	Project-/problem-based Learning	1 1		
Genetics and Molecular Biology (L0886)		Lecture	2 2		
ab Course in Microbiology and Bio	chemistry (L0890)	Practical Course	3 3		
Module Responsible	Prof. Johannes Gescher				
Admission Requirements	None				
Recommended Previous	Lecture Biochemistry				
Knowledge	Lecture Microbiology				
Educational Objectives	After taking part successfully, students have re	ached the following learning results			
Professional Competence					
Knowledge	After successfully finishing this module student	s are able			
	 to give an overview of the basic genetic 				
	 to explain basic molecularbiological methods 	nods			
	to give an overview of -omics strategies				
	 to explain genetic differences between p 	ro- and eukaryotes			
Skills	Students are able to				
		ling in the laboratory			
	consider safety measurements when work	King in the laboratory			
	work sterile				
	 cultivate microorganisms aerobically 				
	measure enzyme activity				
	 identify microorganisms based and physiological assays and 16S rRNA encoding gene sequences 				
	 apply core knowledge of the lectures "Big 	ochemistry" and "Microbiology" in laboratory expe	eriments		
	 scientific poster design and presentation 				
Personal Competence					
	Students are able to				
	 conduct laboratory experiments in teams 	5			
	 write protocols in teams 				
	 develop solutions for given problems 				
	 develop and distribute work assignments 	s for given problems			
	 present and reflect their specific knowled 	dge in discussions with fellow students and tutors			
	 present and discuss their own scientific present 	ooster			
Autonomy	Students are able to				
	 search information for a given problem b 	w themselves			
	 prepare summaries of their search result 				
	• prepare summaries of their search result				
Workload in Hours	Independent Study Time 96, Study Time in Lect	ture 84			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description	full-land Datab		
		andErstellung und Präsentation eines wissenscha	ittlichen Posters		
	practical work				
Examination					
Examination duration and	60 min				
scale					
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Chemical and Bioeng	gineering: Compulsory		
Following Curricula	Bioprocess Engineering: Core Qualification: Cor	npulsory			
	Chemical and Bioprocess Engineering: Specialis	ation Bio Engineering: Compulsory			
Course L0889: Genetics and	Molecular Biology				
	Project-/problem-based Learning			_	
- 76					
Hrs/wk	1				

Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Johannes Gescher
Language	DE
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0886: Genetics and	Molecular Biology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Johannes Gescher
Language	
Cycle	WiSe/SoSe
Content	- Organisation, structure and function of procaryotic DNA
	- DNA replication, transcription, translation
	- Regulation of gene expression
	- Mechanisms of gene transfer, recombination, transposition
	- Mutatuion and DNA repair
	- DNA cloning
	- DNA sequencing
	- Polymerase chain reaction
	- Genome sequencing, (meta)genomics, transcriptomics, proteomics
Literature	Rolf Knippers, Molekulare Genetik, Georg Thieme Verlag Stuttgart
	Munk, K. (ed.), Genetik , 2010, Thieme Verlag
	John Ringo, Genetik kompakt, 2006, Elsevier GmbH, München
	T. A. Brown, Gene und Genome, 2007, 3. Aufl., Spektrum Akademischer Verlag,
	Jochen Graw, Genetik, Springer Verlag, Berlin Heidelberg

	Microbiology and Biochemistry
Тур	Practical Course
Hrs/wk	
CP	
	Independent Study Time 48, Study Time in Lecture 42
	Prof. Johannes Gescher, Dr. Paul Bubenheim
Language	
-	WiSe/SoSe
Content	 Widespread techniques of microbiological, biochemical and genetic approaches will be taught during this course. 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. Topics and Methods of the course include: Morphology and growth of different bacteria strains Measuring of microbial growth by turbidity Preparation of several culture media Strain identification by gram staining and analytical profile index (API test) Genetic background identification by 16S rRNA analysis Microscopy BLAST analyses Colony PCR procedure Enzyme activity measurements and kinetics (Michaelis-Menten equation, Lineweaver-Burk plot) Enzyme as biocatalysts (exemplarily use of enzymes in detergents) Measurement of protein concentrations (Bradford protein assay) Qualitative and quantitative enzyme activity assay
Literature	Brock Mikrobiologie / Brock Microbiology (Michael T. Madigan, John M. Martinko)
	Mikrobiologisches Grundpraktikum (Steve K. Alexander, Dennis Strete)

	ical Reaction Engineerin	ng			
ourses					
itle			Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fu	indamentals) (L0204)		Lecture	2	2
Chemical Reaction Engineering (Fu			Recitation Section (large)	2	2
xperimental Course Chemical Eng	jineering (Fundamentals) (L0221)		Practical 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 thermody	/namics I+II as w	ell as computation
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	The students are able to explain b	basic concepts of chemica	al reaction engineering. They are	able to point out	differences betw
-	thermodynamical and kinetical pr	ocesses. The students ha	ave a strong ability to outline pa	arts of isothermal	and non-isother
	ideal reactors and to describe their	r properties.			
Skills	After successful completion of the		e to:		
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,				
	- determine and compute stable operation points for these reactors ,				
	 conduct experiments on a lab-sca 	ale pilot plants and docum	nent these according to scientific	guidelines.	
Personal Competence					
	After successful completition of th	e lab-course the student	s have a strong ability to organiz	e themselfes in s	mall groups to s
	After successful completition of the lab-course the students have a strong ability to organize themselfes in su issues in chemical reaction engineering. The students can discuss their subject related knowledge among e				
	their teachers.	, , , , , , , , , , , , , , , , , , ,	· · · · · · · · · · · · · · · · · · ·		
Autonomy	The students are able to obtain	n further information ar	nd assess their relevance auto	nomously. Studer	nts can apply t
hatohomy	knowldege discretely to plan, prep			lioniousiji otudei	ito cuit appij c
Workload in Hours	Independent Study Time 96, Study				
Credit points					
Course achievement		Descriptio	on		
course achievement		theoretical and			
	practical wo				
Examination	Written exam				
	120 min				
Examination duration and					
Examination duration and scale	General Engineering Science (Gerr	nan program, 7 semester): Specialisation Bioprocess Engin	eering: Compulso	ory
Examination duration and scale Assignment for the					pry
Examination duration and scale	General Engineering Science (Gerr	man program, 7 semester): Specialisation Process Engineer	ring: Compulsory	-
Examination duration and scale Assignment for the	General Engineering Science (Gerr General Engineering Science (Gerr	man program, 7 semester man program, 7 semester): Specialisation Process Engineer	ring: Compulsory	-
Examination duration and scale Assignment for the	General Engineering Science (Gerr General Engineering Science (Gerr Bioprocess Engineering: Core Qual	man program, 7 semester man program, 7 semester lification: Compulsory): Specialisation Process Engineer): Specialisation Chemical and Bio	ring: Compulsory	-
Examination duration and scale Assignment for the	General Engineering Science (Gerr General Engineering Science (Gerr	man program, 7 semester man program, 7 semester lification: Compulsory ring: Core Qualification: Co): Specialisation Process Engineer): Specialisation Chemical and Bio ompulsory	ring: Compulsory pengineering: Con	-

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

Course L0244: Chemical Reaction Engineering (Fundamentals)		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup	
Language	DE	
Cycle	WiSe	
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)	
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions) Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy,	

	enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers) Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0, 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, interversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics) Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of a membrane reactor, wole balance of a con
	of a reactor)
Literature	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

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

Module M1764: Biopr	ocess Technology I			
Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Technology I (L2906)		Lecture	2	2
Bioprocess Technology I (L2907)		Recitation Section (large)	2	2
Bioprocess Technology I - Fundame	ental Practical Course (L2908)	Practical Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	2 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Chemical and Bio	engineering: Con	npulsory
	Chemical and Bioprocess Engineering: Core Qualifi			

Course L2906: Bioprocess Technology I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2907: Bioprocess Technology I	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2908: Bioprocess Technology I - Fundamental Practical Course		
Тур	Practical Course	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Andreas Liese	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture	2	2
Thermal Separation Processes (L01		Recitation Section (small)	2	2
Thermal Separation Processes (L01	.41)	Recitation Section (large) Practical Course	1	1
Separation Processes (L1159)	<u> </u>	Plactical Course	1	I
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics II	1		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge				
	 The students can distinguish and describ adsorption The students develop an understanding fo energy demand of a process, the possibiliti They have good knowledge of designing m 	or the course of concentration during a sep ies of energy saving, and the selection of se	aration process, t paration systems	
Skills	 Using the gained knowledge the students of close the associated energy and material b The students can use different graphical theoretical stages required They can select and design a basic type disadvantages of the process The students are capable to obtain indepertables) They can calculate continuous and disconti The students are able to prove their theore The students are capable to discuss the theor colloquium. 	palances methods for the designing of a separation of thermal separation process for a given endently the needed material properties fro inuous processes etical knowledge in the experimental lab wo etical background and the content of the eti- enowledge with the content of other lectures	on process and do n case based on om appropriate so rk. xperimental work s and use it togeth	efine the amour the advantages urces (diagrams with the teache
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results 	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by th	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neet The students can proof the state of their 	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by th	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neet The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re eded information from suitable sources by th r knowledge with exam resembling assign	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours	 The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the need. The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re eded information from suitable sources by th r knowledge with exam resembling assign	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re eded information from suitable sources by th r knowledge with exam resembling assign	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re eded information from suitable sources by th r knowledge with exam resembling assign	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re eded information from suitable sources by th r knowledge with exam resembling assign	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process 	al lab work in small groups and organize as and to document them scientifically in a re- eded information from suitable sources by th r knowledge with exam resembling assign re 84	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	 The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture 6 None Written exam 120 minutes; theoretical questions and calculation 	al lab work in small groups and organize as and to document them scientifically in a re- eded information from suitable sources by th r knowledge with exam resembling assign re 84	a functional divisi aport. nemselves and ass	on of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	 The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture 6 None Written exam 120 minutes; theoretical questions and calculation 	al lab work in small groups and organize as and to document them scientifically in a re aded information from suitable sources by th r knowledge with exam resembling assign re 84	a functional divisi aport. nemselves and ass nments and in th	on of labor betw sess their quality is way control t
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I 20 minutes; theoretical questions and calculation General Engineering Science (German program, 7	al lab work in small groups and organize as and to document them scientifically in a re aded information from suitable sources by th r knowledge with exam resembling assign re 84	a functional divisi aport. nemselves and ass nments and in th	on of labor betw sess their quality is way control t
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I 20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84	a functional divisi apport. nemselves and ass nments and in th	on of labor betw sess their quality is way control t able Energy: Elec
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the need The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Keenergy	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84	a functional divisi apport. nemselves and ass nments and in th	on of labor betw sess their quality is way control t able Energy: Elec
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture 6 None Written exam 120 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program Compulsory	al lab work in small groups and organize a s and to document them scientifically in a re- eded information from suitable sources by th r knowledge with exam resembling assign re 84 re 84 rs r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program)	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 rs r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulso	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 General Engineering Science (German program)	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 rs r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech semester): Specialisation Green Tech semester): Specialisation Bioprocess Engine	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program)	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 rs r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech semester): Specialisation Green Tech semester): Specialisation Bioprocess Engine	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 General Engineering Science (German program)	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 rs r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech rection Green Tech semester): Specialisation Green Tech semester): Specialisation Bioprocess Engine rection Specialisation Process Engineer rection Specialisation Chemical and Bio	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Konne Written exam I20 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 General Eng	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 re semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech ? semester): Specialisation Green Tech ? semester): Specialisation Bioprocess Engine ? semester): Specialisation Process Engine ? semester): Specialisation Chemical and Bio ulsory	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assignment The students are able to carry out practice them. They are able to discuss their results The students are capable to obtain the neee The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture Keeneral Engineering Science (German program, 7 General Engineering Science (German program	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 re 84 re semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech ? semester): Specialisation Green Tech ? semester): Specialisation Bioprocess Engine ? semester): Specialisation Process Engine ? semester): Specialisation Chemical and Bio ulsory fication: Compulsory	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the need The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture 6 None Written exam 120 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Comp	al lab work in small groups and organize a s and to document them scientifically in a re eded information from suitable sources by the r knowledge with exam resembling assign re 84 semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech ? semester): Specialisation Green Tech ? semester): Specialisation Green Tech ? semester): Specialisation Bioprocess Engine ? semester): Specialisation Process Engine ? semester): Specialisation Chemical and Bio ulsory fication: Compulsory lification: Elective Compulsory	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory pengineering: Com	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 The students can work technical assignment The students are able to carry out practic them. They are able to discuss their results The students are capable to obtain the need The students can proof the state of their learning process Independent Study Time 96, Study Time in Lecture 6 None Written exam 120 minutes; theoretical questions and calculation General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7	al lab work in small groups and organize a s and to document them scientifically in a re- eded information from suitable sources by th r knowledge with exam resembling assign re 84 re 84 ns r semester): Specialisation Green Technolog n, 7 semester): Specialisation Green Tech reck r semester): Specialisation Green Tech reck r semester): Specialisation Bioprocess Engine r semester): Specialisation Process Engine r semester): Specialisation Chemical and Bio ulsory fication: Compulsory lification: Elective Compulsory cialisation Energy Systems: Elective Compu	a functional divisi eport. nemselves and ass nments and in th gies, Focus Renew nnologies, Focus neering: Compulsory pengineering: Com lsory	on of labor betw sess their quality is way control t able Energy: Elec Renewable Ene

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

ırse L0119: Thermal Sepa	ration Processes
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Selection of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separatic processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 198 Ullmann"s Enzyklopädie der Technischen Chemie

rse L0141: Thermal Sepa	
Тур	Recitation Section (large)
Hrs/wk	
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 separatic processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 198 Ullmann"s Enzyklopädie der Technischen Chemie

Course L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they car increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Advance overview of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separatio processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 198-Ullmann"s Enzyklopädie der Technischen Chemie

Courses					
Title		Тур	Hrs/wk	СР	
Heat and Mass Transfer (L0101)		Lecture	2	2	
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2	
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2	
Module Responsible	Prof. Irina Smirnova				
Admission Requirements	None				
Recommended Previous	Basic knowledge: Technical Thermodynami	ics			
Knowledge					
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results			
Professional Competence					
Knowledge					
	heat exchanger, chemical reactors).They are capable of distinguish and transfer and thermal radiation.The students have the ability to e qualitative and quantitative by using	characterize different kinds of heat transfer mec explain the physical basis for mass transfer in	hanisms namely h detail and to de	neat conduction, h	
Skills	 and to balance the corresponding en They are capable to solve specific h and to calculate the corresponding h Using dimensionless quantities, the s They are able to distinguish between for the description and design of app In this context, the students are cap application considering their advanta In addition, they can calculate both, The students are capable to complete t	neat transfer problems (e.g. heated chemical rea	ctors, temperatur esses or apparatu transfer. They car nn). heat and mass exu procedural apparat with knowlegde	e alteration in flui is. In use this knowled changer for a spec- tus. of other courses	
Personal Competence Social Competence	• The students are capable to work or manner to tutors and other students	n subject-specific challenges in teams and to pre	esent the results o	orally in a reasona	
Autonomy	• They are able to prove their level	aluate necessary information from suitable sourc of knowledge during the course with accompa I on this basis they can control their learning proc	nying procedure	continuously (click	
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56			
Credit points					
Course achievement					
Examination					
		aulations.			
Examination duration and	120 minutes; theoretical questions and cald	นแลนปกร			
scale	General Engineering Science (German proc	gram, 7 semester): Specialisation Green Technolo	gies: Compulsory		
scale					
scale Assignment for the		gram, 7 semester): Specialisation Bioprocess Engi	5 1	ory	
scale Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Bioprocess Engi gram, 7 semester): Specialisation Process Enginee	÷ ,	-	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog		ering: Compulsory	-	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog	gram, 7 semester): Specialisation Process Enginee gram, 7 semester): Specialisation Chemical and B	ering: Compulsory	-	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification:	ram, 7 semester): Specialisation Process Enginee gram, 7 semester): Specialisation Chemical and B : Compulsory	ering: Compulsory	-	
scale Assignment for the Following Curricula	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification: Chemical and Bioprocess Engineering: Core	gram, 7 semester): Specialisation Process Enginee gram, 7 semester): Specialisation Chemical and B : Compulsory e Qualification: Compulsory	ering: Compulsory	-	
scale Assignment for the Following Curricula	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification: Chemical and Bioprocess Engineering: Core Energy and Environmental Engineering: Co	gram, 7 semester): Specialisation Process Enginee gram, 7 semester): Specialisation Chemical and B : Compulsory e Qualification: Compulsory re Qualification: Compulsory	ering: Compulsory	-	
scale Assignment for the Following Curricula	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification: Chemical and Bioprocess Engineering: Core	gram, 7 semester): Specialisation Process Engine gram, 7 semester): Specialisation Chemical and B : Compulsory e Qualification: Compulsory re Qualification: Compulsory :e: Core Qualification: Compulsory	ering: Compulsory	-	

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Material Engineering (L2894)		Lecture	2	3
Module Responsible	Dr. Marko Hoffmann			
Admission Requirements	None			
Recommended Previous Knowledge	General and Inorganic ChemistryPhase Equilibria Thermodynamics			
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence				
	A basic knowledge of materials science is necessary for the module therefore focuses on ferrous materials, although po of atomic structure, microstructure, phase transformation, necessary for materials selection and for the evaluation of one-semester module. Students will also have basic knowl essential methods of materials testing and the corrosion p knowledge of the main types of steel used in process engin- of steels in practice in the context of time-temperature trans Students will be able to select suitable materials for the di- strength, ductility, toughness and fatigue strength are ta corrosion resistance. In addition to specifying strength-in	lymer materials and cera diffusion, state diagrams corrosion and wear pro ledge in the area of me rocesses that are very r eering and knowledge of sformation diagrams (TT esign of process plants a aken into account. Stud	amics are also covered. A s, and alloy formation, an cesses, which students sl chanical properties of ma elevant in practice. In ad- the most important heat Γ diagrams). and apparatus. Mechanica ents can also specify m	basic understandi nong other things, nould acquire in tl terials including t dition, students ga treatment process al properties such easures to increa
Personal Competence	mechanical properties, such as heat treatment processes.			
	The students are able to work out results in groups and do	ocument them, provide ;	appropriate feedback and	handle feedback
	their own performance constructively.			
Autonomy	Students are able to independently assess their level of la materials engineering. Students are also able to independe this to the context of the course, e.g. when selecting a mate	ntly seek out information	n from subject-specific pu	-
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester Chemical and Bioprocess Engineering: Specialisation Chemic	•		npulsory

Course L2894: Material Engir	ieering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W.,Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.

Courses							
Title				Ту	p	Hrs/wk	СР
Particle Technology I (L0434)				Lee	cture	2	3
Particle Technology I (L0435)					citation Section (small)	1	1
Particle Technology I (L0440)				Pra	actical Course	2	2
Module Responsible	Prof. Stefan	Heinrich					
Admission Requirements	None						
Recommended Previous	keine						
Knowledge							
Educational Objectives	After taking	part succ	essfully, students have re-	ached the following I	earning results		
Professional Competence							
Knowledge	After succes	ssful com	pletion of the module stude	ents are able to			
	• name	e and exp	ain processes and unit-op	erations of solids pro	ocess engineering,		
			articles, particle distributio				
Skills	Students are	e able to					
			sign apparatuses and proc			esired solids prop	perties of the produ
	 asses solids with respect to their behavior in solids processing steps 						
	 docur 	ment thei	r work scientifically.				
Personal Competence							
Social Competence	The student	ts are ab	le to discuss scientific top	pics orally with othe	r students or scientific p	ersonal and to o	develop solutions
	technical-sc	ientific is	sues in a group.				
Autonomy	Students are	e able to	analyze and solve questior	ns regarding solid pa	rticles independently.		
Westered to Herror	to do a condense	L Church T	and 110. Church Times in La				
Workload in Hours		t Study I	me 110, Study Time in Le	cture 70			
Credit points	6 Compulsory	Bonus	Form	Description			
Course achievement		None	Written elaboration		oro Versuch ein Bericht) à	5-10 Seiten	
Examination	Written exa	m					
Examination duration and	90 minutes						
scale							
Assignment for the	General End	aineerina	Science (German program	n. 7 semester): Speci	ialisation Green Technolo	aies. Focus Wate	r and Environment
Following Curricula			Compulsory	,, ,,		5	
, , , , , , , , , , , , , , , , , , ,			Science (German program	, 7 semester): Specia	lisation Bioprocess Engin	eering: Compulso	ory
	-	-	Science (German program				-
	-	-	Science (German program		-		npulsory
	-	-	ng: Core Qualification: Con				
	-		ess Engineering: Core Qua		ry		
			ental Engineering: Core Q				
			Energy, Water, Climate: Sp				
		9					

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

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

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

Courses						
Title				Тур	Hrs/wk	СР
Process and Plant Engineering I (L0095)			Lecture Recitation Section (large)	2 1	4 1	
Process and Plant Engineering I (L0096) Process and Plant Engineering I (L1214)				Recitation Section (small)	1	1
Module Responsible						
Admission Requirements	None					
Recommended Previous						
Knowledge	-housing and some the solution					
	chemical reactor eingineering					
Educational Objectives	After taking part succ	essfully, students have r	eached the following	ng learning results		
Professional Competence						
Knowledge	students can:					
	classify and formulate	e blobal balance equation	ns of chemical proc	esses		
	specify linear compor	nent equations of comple	ex chemical process	Ses		
	explain linear regression and data reconcilliation problems					
	explain pfd-diagrams					
CL 11		<i>.</i>				
SKIIIS	students are capable of					
	- formulation of mass and energy balance equations and estimation of product streams					
	- estimation of component streams of chemical plants using linear component balance models					
	- solution of data reco	solution of data reconcilliation tasks				
	- conduction of proce	ss synthesis				
	- economic evaluation of processes and the estimation of production costs					
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 124, Study Time in L	ecture 56			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 10 %	Subject theoretical	and			
Examination	Writton oxam	practical work				
Examination duration and	Written exam					
scale	120 Min. lectures hot					
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Spe	ecialisation Bioprocess Engin	eering: Compulso	ory
					÷ ,	-
•	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory					
	Bioprocess Engineering: Core Qualification: Compulsory					
	Chemical and Bioproc	cess Engineering: Core Q	ualification: Compu	Ilsory		
	Green Technologies:	Energy, Water, Climate:	Specialisation Biore	esource Technology: Elective	Compulsory	
	Process Engineering:	Core Qualification: Comp	oulsory			

urse L0095: Process and P	lant Engineering I			
Тур	Lecture			
Hrs/wk	2			
CP				
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28			
Lecturer	Prof. Mirko Skiborowski			
Language	DE			
Cycle	SoSe			
Content	1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation 3. Process Synthesis			

	Decision levels Experimental process development
	Reactor synthesis
	Synthesis of separation processes (process alternatives and criteria for selection)
	Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety
	5. Cost estimation of production plants
	Production costs, capital costs, economic evaluation
Literature	
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
	H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74
	Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157
	E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997
	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916
	R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte,
	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
	J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988
	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
	G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306
	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
	G. Kaibel, Dissertation, TU München, 1987
	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process and P	ourse L0096: Process and Plant Engineering I				
Тур	Recitation Section (large)				
Hrs/wk	1				
CP	1				
Workload in Hours	ependent Study Time 16, Study Time in Lecture 14				
Lecturer	. Mirko Skiborowski, Dr. Thomas Waluga				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Course L1214: Process and P	ourse L1214: Process and Plant Engineering I				
Тур	Recitation Section (small)				
Hrs/wk	1				
CP	1				
Workload in Hours	ependent Study Time 16, Study Time in Lecture 14				
Lecturer	Mirko Skiborowski, Dr. Thomas Waluga				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Specialization Electrical Engineering

The educational objective of the General Engineering Science BSc program's electrical engineering specialization is to develop the ability to choose and combine fundamental methods and processes in order to solve technical tasks in engineering science and, especially, the specialization subject.

Graduates will have

1) A firm grounding in mathematics, physics, electrical engineering, and computer science

2) A basic knowledge of systems theory, control systems, and electrical power and energy or measurement technology

3) In-depth knowledge of engineering science areas, especially their specialization area (electrical engineering materials and components, semiconductor technology, communications engineering, electromagnetig theory). They will, in particular, have the methodological skills required for applying their knowledge to the solution of technical problems, taking technical, economic and societal requirements into account.

Module M0708: Electrical Engineering III: Circuit Theory and Transients

Courses					
Courses					
Title Circuit Theory (L0566)		Typ Lecture	Hrs/wk 3	CP 4	
Circuit Theory (L0566) Circuit Theory (L0567)		Recitation Section (small)	2	2	
Module Responsible	Prof. Alexander Kölpin	Rectation Section (Small)	Z	2	
Admission Requirements					
	Electrical Engineering I and II, Mathematics I	and II			
Knowledge	Liectrical Engineering Fand II, Mathematics I				
Kilowieuge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
•	Students are able to explain the basic meth	nods for calculating electrical circuits. They know	w the Fourier ser	ies analysis of line	
raiomeage		now the methods for transient analysis of linea		-	
		quency behaviour and the synthesis of passive tw			
Skills	The students are able to calculate currents	and voltages in linear networks by means of	basic methods,	also when driven l	
	periodic signals. They are able to calculate ti	ansients in electrical circuits in time and frequen	cy domain and a	re able to explain t	
	respective transient behaviour. They are a	ble to analyse and to synthesize the frequency	/ behaviour of p	assive two-termina	
	circuits.				
Personal Competence					
Social Competence	Students work on exercise tasks in small g	juided groups. They are encouraged to present	and discuss the	eir results within t	
	group.				
Autonomy	The students are able to find out the require	d methods for solving the given practice probler	ns. Possibilities a	re given to test th	
	knowledge during the lectures continuous	y by means of short-time tests. This allows	them to control	independently th	
	educational objectives. They can link their ga	ained knowledge to other courses like Electrical E	ingineering I and	Mathematics I.	
	Independent Study Time 110, Study Time in	Lecture 70			
Credit points Course achievement					
	Written exam				
Examination duration and					
scale					
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Mechanica	I Engineering,	Focus Mechatroni	
Following Curricula	Compulsory				
	General Engineering Science (German progra	am, 7 semester): Specialisation Electrical Enginee	ering: Compulsor	y	
	Electrical Engineering: Core Qualification: Co	mpulsory			
	Engineering Science: Specialisation Electrical Engineering: Compulsory				
	Computer Science in Engineering: Specialisa	tion II. Mathematics & Engineering Science: Elect	ive Compulsory		
	Mechatronics: Core Qualification: Compulsor	ý			
	Technomathematics: Specialisation III. Engin	eering Science: Elective Compulsory			

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

urse L0567: Circuit Theory				
Recitation Section (small)				
2				
2				
Independent Study Time 32, Study Time in Lecture 28				
Prof. Alexander Kölpin, Dr. Fabian Lurz				
DE				
WiSe				
see interlocking course				
siehe korrespondierende Lehrveranstaltung				

Courses					
Title		Тур	Hrs/wk	СР	
Computer Engineering (L0321)		Lecture	3	4	
Computer Engineering (L0324)		Recitation Section (small)	1	2	
Module Responsible					
Admission Requirements	None				
Recommended Previous	Basic knowledge in electrical engineering				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the	e following learning results			
Professional Competence					
Knowledge	This module deals with the foundations of the function		s the layers from	n the assembly-le	
	programming down to gates. The module includes the	onowing topics.			
	Introduction				
	Combinational logic: Gates, Boolean algebra, Boolean	blean functions, hardware synthesis, c	ombinational net	works	
	 Sequential logic: Flip-flops, automata, systematic 	: hardware design			
	Technological foundations				
	Computer arithmetic: Integer addition, subtraction		- la - lla la -		
	Basics of computer architecture: Programming n Momoria: Momory biographics SBAM_DBAM_ca		pipelining		
	 Memories: Memory hierarchies, SRAM, DRAM, ca Input/output: I/O from the perspective of the CPU 		oint connections	husses	
	purjourput i o nom the perspective of the Crt	, principles of passing data, point-to-p	Sine connections	, 200000	
Skills	The students perceive computer systems from the arch	itect's perspective, i.e., they identify t	he internal struc	ture and the physi	
	composition of computer systems. The students can ar				
	collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of				
	today's computing systems - from gates and circuits up	to complete processors.			
	After successful completion of the module, the stude	its are able to judge the interdepend	encies between	a physical compu	
	system and the software executed on it. In particular,	hey shall understand the consequenc	es that the exec	ution of software I	
	on the hardware-centric abstraction layers from the as	sembly language down to gates. This	way, they will be	e enabled to evaluate	
	the impact that these low abstraction levels have on ar	entire system's performance and to p	ropose feasible	options.	
Personal Competence					
	Students are able to solve similar problems alone or in	a group and to present the results acc	ordinaly		
Social competence	stadents die able to solve sinniar problems alone of in a group and to present the results decordingly.				
Autonomy	Students are able to acquire new knowledge from spec	fic literature and to associate this kno	wledge with othe	er classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement		ription			
course demeterment	Yes 10 % Excercises				
Examination	Written exam				
Examination duration and	90 minutes, contents of course and labs				
scale					
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Computer Scienc	e: Compulsory		
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering,	Focus Mechatroni	
	Compulsory				
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Syste	
	Engineering: Compulsory				
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engin	neering, Focus Th	neoretical Mechani	
	Engineering: Compulsory	comostor), Cresislication Mart	al Engine	Focus Mataria	
	General Engineering Science (German program, 7 Engineering Sciences: Compulsory	semester): specialisation Mechanic	aı Engineering,	rocus Materials	
	General Engineering Science (German program, 7 sen	ester): Specialisation Mechanical Eng	ineering Focus	Product Developm	
	and Production: Compulsory	ester). Specialisation mechanical Eng	ineering, rocus i	Toddet Developin	
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering, Foo	us Energy Syster	
	Compulsory		,	5, -, -	
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, l	Focus Biomechani	
	Compulsory				
	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Engine	ering: Compulsor	У	
	General Engineering Science (German program, 7 seme	ester): Specialisation Green Technolog	ies, Focus Renew	able Energy: Elect	
	Compulsory				
	Computer Science: Core Qualification: Compulsory				
	Data Science: Core Qualification: Elective Compulsory				
	Data Science: Specialisation I. Mathematics/Computer S	cience: Elective Compulsory			
	Electrical Engineering: Core Qualification: Compulsory				
	Computer Science in Engineering: Core Qualification: C				
	Integrated Building Technology: Core Qualification: Electronomathematics: Specialisation II. Informatics: Electronomathematics: Electronomathematics: Appendix Append				

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Theoretical Electrical Engineering I Theoretical Electrical Engineering I	-	Lecture Recitation Section (small)	3 2	5 1	
Module Responsible	Prof. Christian Schuster				
Admission Requirements	nts None				
Recommended Previous Knowledge	Basic principles of electrical engineering and adv	vanced mathematics			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence Knowledge	Students can explain the fundamental formulas, They can explicate the principal behavior of e sources. They can describe the properties of c fields. The students are aware of applications for these.	lectrostatic, magnetostatic, and current of omplex electromagnetic fields by means	lensity fields with of superposition o	regard to respection f solutions for simp	
Skills	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independent electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell' Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields an analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications.				
Personal Competence Social Competence	Students are able to work together on subject related tasks in small groups. They are able to present their results effectively (e during exercise sessions).				
Autonomy	Students are capable to gather necessary information from provided references and relate this information to the lecture. They able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their indivi learning process. They are able to draw connections between their knowledge obtained in this lecture and the content of o lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis).				
Workload in Hours	Independent Study Time 110, Study Time in Lect	ture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	90-150 minutes				
Assignment for the Following Curricula	General Engineering Science (German program, Electrical Engineering: Core Qualification: Compu Computer Science in Engineering: Specialisation	ilsory		у	

	lectrical Engineering I: Time-Independent Fields Lecture		
Hrs/wk			
CP			
	Independent Study Time 108, Study Time in Lecture 42		
Lecturer	Prof. Christian Schuster		
Language	DE		
Cycle			
Content	- Maxwell's Equations in integral and differential notation		
	- Boundary conditions		
	- Laws of conservation for energy and charge		
	- Classification of electromagnetic field properties		
	- Integral characteristics of time-independent fields (R, L, C)		
	- Generic approaches to solving Poisson's Equation		
	- Electrostatic fields and specific methods of solving		
	- Magnetostatic fields and specific methods of solving		
	- Fields of electrical current density and specific methods of solving		
	- Action of force within time-independent fields		
	- Numerical methods for solving time-independent problems		
	The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs.		
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)		
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)		
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)		
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)		
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)		
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)		

Course L0181: Theoretical El	urse L0181: Theoretical Electrical Engineering I: Time-Independent Fields	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Christian Schuster	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

	ials in Electrical Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Electrotechnical Experiments (L071		Lecture	1 2	1 3
Materials in Electrical Engineering (L0685) Materials in Electrical Engineering (Problem Solving Course) (L0687)		Lecture Recitation Section (small)	2	2
Module Responsible				
Admission Requirements				
Recommended Previous	Highschool level physics and mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
-	Students can explain the composition and the structural properties of materials used in electrical engineering. Students explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of the applications in electrical engineering. Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solution			
2.002		nance of materials in electrical engineering applic		
Personal Competence				
Social Competence	Students can jointly solve subject related p problem solving course.	roblems in groups. They can present their results	s effectively within	the framework of
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exar typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Electrical Engin	eering: Compulsor	у
Following Curricula	Electrical Engineering: Core Qualification: C	Compulsory		

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

urse L0685: Materials in Electrical Engineering			
Тур	Lecture		
Hrs/wk			
	3		
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Manfred Eich		
Language			
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		
Litoratura	1.Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials,		
Literature	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		
	13.Wikipedia, Wikimedia		

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

Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular comp	lexe numbers, integrals, differentials		
Knowledge	Resident of electrical engineering and mach			
	Basics of electrical engineering and mech			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basi	ic principles of electric and magnetic fields.		
	They can describe the function of the	standard types of electric machines and p	resent the correspor	nding equations a
		rives they can explain the major parameters of		
	from the power grid to the driven engine.			
Chille	Chudente ere able te coloulate ture dimen	signal alastric and magnatic fields in narticula	e formana anatio aire	wite with air as f
SKIIIS	this they apply the usual methods of the c	nsional electric and magnetic fields in particula	ir terromagnetic circ	uits with air gap. I
	this they apply the usual methods of the c	lesign dur electric machines.		
	They can calulate the operational perform	mance of electric machines from their given cl	naracteristic data an	d selected quantit
	and characteristic curves. They apply the	usual equivalent circuits and graphical methods	5.	
Personal Competence				
Social Competence			- T heorem a blacks a	
Autonomy		ate electric and magnatic fields for application nachines from the charactersitic data and the		
	and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Design of four machines and actuators, re	view of design files		
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Electrical Eng	jineering: Elective Co	ompulsory
Following Curricula		program, 7 semester): Specialisation Mechani	cal Engineering, Foo	cus Energy Syster
	Compulsory	nyanyan 7 competer), Createlization Mach	nicel Engineering	Feele Mechatroni
	Compulsory	program, 7 semester): Specialisation Mecha	inical Engineering,	Focus Mechatroni
		ogram, 7 semester): Specialisation Mechanical (Engineering, Focus T	heoretical Mechani
	Engineering: Elective Compulsory	g, · · · · · · · · · · · · · · · · ·		
	Digital Mechanical Engineering: Core Qual	ification: Compulsory		
	Electrical Engineering: Core Qualification:	Elective Compulsory		
	Engineering Science: Specialisation Electr	ical Engineering: Elective Compulsory		
	5 5,7	te: Specialisation Energy Technology: Elective	Compulsory	
	Logistics and Mobility: Specialisation Engin			
		ic Planning and Systems: Elective Compulsory	mpulcon	
	Logistics and Mobility: Specialisation Prod Mechanical Engineering: Core Qualification	uction Management and Processes: Elective Con	привогу	
	Mechatronics: Core Qualification: Compuls			
	Technomathematics: Specialisation III. En			
		ogistics and Mobility: Specialisation Traffic Plan	ning and Systems: Fi	lective Compulsory
		ogistics and hobinty. Specialisation marine nam		cenve compuisory
		Logistics and Mobility: Specialisation Producti		

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

Course L0294: Electrical Mac	Course L0294: Electrical Machines and Actuators	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thorsten Kern, Dennis Kähler	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Madula Moora at at				
Module M0854: Mathe	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
	None			
	Mathematics I - III			
Knowledge	Mathematics I - III			
	After taking part successfully, students have reach	hed the following learning results		
Professional Competence				
Knowledge	Students can name the basic concents in M	athematics IV. They are able to explain the		to overnles
	Students can name the basic concepts in Ma			
	Students can discuss logical connections be	etween these concepts. They are capable	or illustrating the	ese connections wit
	the help of examples.			
	 They know proof strategies and can reprodu 	uce them.		
Skills				
	 Students can model problems in Mathematical 		ed in this course	. Moreover, they ar
	capable of solving them by applying establis	shed methods.		
	 Students are able to discover and verify further 	ther logical connections between the conce	pts studied in the	course.
	 For a given problem, the students can de- 	velop and execute a suitable approach, a	nd are able to c	itically evaluate th
	results.			
Personal Competence				
Social Competence	 Students are able to work together in teams 	s. They are capable to use mathematics as	a common langua	age.
	 In doing so, they can communicate new cor 	ncepts according to the needs of their coo	perating partners	Moreover, they ca
	design examples to check and deepen the u	understanding of their peers.		
		j		
Autonomy	 Students are capable of checking their und 	lerstanding of complex concepts on their c	wn. They can sp	ecify open question
	precisely and know where to get help in sol		- , - , - ,	
	 Students have developed sufficient persist 	-	ls in a goal-orient	ed manner on har
		lence to be able to work for longer period	is in a goal-onen	
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture	e 112		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	60 min (Complex Functions) + 60 min (Differential	Equations 2)		
	oo min (complex runctions) + oo min (Differential			
scale				
-	General Engineering Science (German program, 7			
Following Curricula	General Engineering Science (German program	n, 7 semester): Specialisation Mechanica	al Engineering, I	ocus Mechatronic
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engin	neering, Focus Th	eoretical Mechanic
	Engineering: Elective Compulsory			
	Electrical Engineering: Core Qualification: Compuls	sory		
	General Engineering Science (English program, 7 s	-	rina: Compulsory	
	Computer Science in Engineering: Specialisation II.			
			e compulsory	
	Mechanical Engineering: Specialisation Mechatroni			
	Mechanical Engineering: Specialisation Theoretical	I Mechanical Engineering: Elective Compuls	or y	
	Mechatronics: Core Qualification: Compulsory		lor y	
		/	-	

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

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

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

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

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

Course L1042: Complex Func	ourse 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	
	nas, and Electromagnetic Compatibility (L1669) nas, and Electromagnetic Compatibility (L1877)	Lecture Recitation Section (small)	3 2	4	
		Reclation Section (Small)	Z	2	
-	Prof. Christian Schuster None				
Admission Requirements Recommended Previous	Basic principles of physics and electrical engineering				
Knowledge	basic principles of physics and electrical engineering				
Educational Objectives	After taking part successfully, students have reached th	o following loarning rosults			
Professional Competence	Arter taking part successiony, students have reached th				
	Students can explain the basis principles, relationship	c and mathada for the decign of wa	voquidos and an	toppos os well os	
Knowledge	Students can explain the basic principles, relationship Electromagnetic Compatibility. Specific topics are:	s, and methods for the design of wa	veguides and an	terinas as well as	
	Electromagnetic compatibility. Specific topics are.				
	- Fundamental properties and phenomena of electrical	ircuits			
	- Steady-state sinusoidal analysis of electrical circuits				
	- Fundamental properties and phenomena of electroma	gnetic fields and waves			
	- Steady-state sinusoidal description of electromagnetic	fields and waves			
	- Useful microwave network parameters				
	- Transmission lines and basic results from transmission line theory				
	- Plane wave propagation, superposition, reflection and refraction				
	- General theory of waveguides				
	- Most important types of waveguides and their properties				
	- Radiation and basic antenna parameters				
	- Most important types of antennas and their properties				
	- Numerical techniques and CAD tools for waveguide and antenna design				
	- Fundamentals of Electromagnetic Compatibility				
	- Coupling mechanisms and countermeasures				
	- Shielding, grounding, filtering				
	- Standards and regulations				
	- EMC measurement techniques				
Skills	Students know how to apply various methods and more	lels for characterization and choice of	waveguides and	l antennas. They a	
	able to assess and qualify their basic electromagne				
	Electromagnetic Compatibility to the development of ele				
Personal Competence					
Social Competence	Students are able to work together on subject related	tasks in small groups. They are able	to present their	results effectively	
	English (e.g. during small group exercises).				
Autonomy	Students are capable to gather information from sub	ject related, professional publication	s and relate tha	t information to th	
	context of the lecture. They are able to make a conne				
	other lectures (e.g. theory of electromagnetic fields, fu				
	problems and physical effects in English.	, , , , , , , , , , , , , , , , , , ,			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement					
Examination	Oral exam				
Examination duration and	45 min				
scale					
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Engine	erina: Elective Co	mpulsory	
Following Curricula	Electrical Engineering: Core Qualification: Elective Com				
ing carricula	Engineering Science: Specialisation Electrical Engineeri	•			
	Aircraft Systems Engineering: Core Qualification: Electiv	5 1 5			
	Mechatronics: Specialisation System Design: Elective C				

Tun	Lecture
	3
	4
	4 Independent Study Time 78, Study Time in Lecture 42
	Prof. Christian Schuster
Language	
Cycle	This course is intended as an introduction to the topics of wave propagation, guiding, sending, and receiving as well a
	Electromagnetic Compatibility (EMC). It will be useful for engineers that face the technical challenge of transmitting high frequence
	/ high bandwidth data in e.g. medical, automotive, or avionic applications. Both circuit and field concepts of wave propagation
	and Electromagnetic Compatibility will be introduced and discussed.
	Topics:
	- Fundamental properties and phenomena of electrical circuits
	- Steady-state sinusoidal analysis of electrical circuits
	- Fundamental properties and phenomena of electromagnetic fields and waves
	- Steady-state sinusoidal description of electromagnetic fields and waves
	- Useful microwave network parameters
	- Transmission lines and basic results from transmission line theory
	- Plane wave propagation, superposition, reflection and refraction
	- General theory of waveguides
	- Most important types of waveguides and their properties
	- Radiation and basic antenna parameters
	 Most important types of antennas and their properties Numerical techniques and CAD tools for waveguide and antenna design
	- Fundamentals of Electromagnetic Compatibility
	- Coupling mechanisms and countermeasures
	- Shielding, grounding, filtering
	- Standards and regulations
	- EMC measurement techniques
Literature	- Zinke, Brunswig, "Hochfrequenztechnik 1", Springer (1999)
	- J. Detlefsen, U. Siart, "Grundlagen der Hochfrequenztechnik", Oldenbourg (2012)
	- D. M. Pozar, "Microwave Engineering", Wiley (2011)
	- Y. Huang, K. Boyle, "Antenna: From Theory to Practice", Wiley (2008)
	- H. Ott, "Electromagnetic Compatibility Engineering", Wiley (2009)
	- A. Schwab, W. Kürner, "Elektromagnetische Verträglichkeit", Springer (2007)

Course L1877: Introduction t	ourse L1877: Introduction to Waveguides, Antennas, and Electromagnetic Compatibility	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Christian Schuster	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
		Tree	Line (suit	CD
Title Theoretical Electrical Engineering I	- Time-Dependent Fields (I 0182)	Typ Lecture	Hrs/wk 3	CP 5
Theoretical Electrical Engineering I	-	Recitation Section (small)	2	1
	Prof. Christian Schuster			
Admission Requirements				
Recommended Previous	Electrical Engineering I, Electrical Engineering II,	Theoretical Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, I	Mathematics IV		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence		5 5		
Knowledge	Students are able to explain fundamental electromagnetic fields. They can assess the prir regard to respective sources. They can describ solutions for simple fields. The students are awa able to explicate these.	ncipal behavior and characteristics of quasist be the properties of complex electromagneti	ationary and full c fields by mean	y dynamic fields wi s of superposition
Skills	Students are able to apply a variety of procedur field problems. They can assess the principal e They can deduce meaningful quantities for the vector, radiation resistance, etc.) from given fiel	ffects of given time-dependent sources of fie e characterization of fully dynamic fields (wa	elds and analyze ave impedance, s	these quantitative
Personal Competence Social Competence	Students are able to work together on subject r	elated tasks in small groups. They are able to	present their re	sults effectively (e.
<i>p</i>	during exercise sessions).			
Autonomy	Students are capable to gather necessary inform able to continually reflect their knowledge by mu- lectures and exercises that are related to the ex- learning process. They are able to draw con University of Technology (TUHH), e.g. in the area	eans of activities that accompany the lecture am. Based on respective feedback, students nections between acquired knowledge and	, such as short of are expected to a	ral quizzes during th adjust their individu
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Electrical Engine	erina: Compulsor	v
Following Curricula	Electrical Engineering: Core Qualification: Comp		g. compaisor	,
3 • • • • • • • •	Engineering Science: Specialisation Electrical En			
	Engineering Science: Specialisation Mechatronic			
	Engineering Science: Specialisation Mechatronic			

Course L0182: Theoretical El	ectrical Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	
Cycle	
Content	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
	The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs.
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

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

Module M1235: Electi	ical Power Systems I: Introduction	to Electrical Power Systems		
Courses				
Title		Тур	Hrs/wk	СР
-	ction to Electrical Power Systems (L1670)	Lecture	3	4
	tion to Electrical Power Systems (L1671)	Recitation Section (small)	2	2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
	Fundamentals of Electrical Engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to give an overview of conventional and modern electric power systems. They can explain in detail and critical evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment in electric power systems.			
Skills	With completion of this module the students are able to apply the acquired skills in applications of the design, integration development of electric power systems and to assess the results.			
Personal Competence				
Social Competence	The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results front of others.			
Autonomy	Students can independently tap knowledge of the	emphasis of the lectures.		
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Enginee	ering: Elective Co	mpulsory
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Green Technologi	ies, Focus Renew	able Energy: Electiv
	Compulsory			
	Data Science: Core Qualification: Elective Compuls	ory		
	Electrical Engineering: Core Qualification: Elective	Compulsory		
	Energy Systems: Specialisation Energy Systems: El	lective Compulsory		
	Engineering Science: Specialisation Electrical Engin	neering: Elective Compulsory		
	Green Technologies: Energy, Water, Climate: Speci	alisation Energy Systems: Elective Compul	sory	
	Computer Science in Engineering: Specialisation II.	Mathematics & Engineering Science: Elect	ive Compulsory	
	Integrated Building Technology: Core Qualification:	Compulsory		
	Renewable Energies: Core Qualification: Compulso			
	Theoretical Mechanical Engineering: Specialisation	Energy Systems: Elective Compulsory		

Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	 fundamentals and current development trends in electric power engineering
	tasks and history of electric power systems
	symmetric three-phase systems
	fundamentals and modelling of eletric power systems
	◦ lines
	• transformers
	 synchronous machines
	 induction machines
	 loads and compensation
	 grid structures and substations
	fundamentals of energy conversion
	 electro-mechanical energy conversion
	 thermodynamics
	 power station technology
	 renewable energy conversion systems
	 steady-state network calculation
	 network modelling
	 load flow calculation
	• (n-1)-criterion
	 symmetric failure calculations, short-circuit power
	control in networks and power stations
	grid protection
	grid planning
	power economy fundamentals
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	 fundamentals and current development trends in electric power engineering
	tasks and history of electric power systems
	symmetric three-phase systems
	 fundamentals and modelling of eletric power systems
	• lines
	• transformers
	 synchronous machines
	 induction machines
	 loads and compensation
	 grid structures and substations
	fundamentals of energy conversion
	 electro-mechanical energy conversion
	 thermodynamics
	 power station technology
	 renewable energy conversion systems
	steady-state network calculation
	network modelling
	 load flow calculation
	• (n-1)-criterion
	 symmetric failure calculations, short-circuit power
	control in networks and power stations
	grid protection
	grid planning
	power economy fundamentals
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Communications an		Lecture	3	4
Introduction to Communications an		Recitation Section (large)	1	1
Introduction to Communications an		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	 Signals and Systems 			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge		damental building blocks of a communications sy	-	
	5 5	dge of signal and system theory as well as the th	,	•
	aware of the essential resources and evalu	uation criteria of information transmission and are	e able to design a	and evaluate a ba
	communications system.			
	The students are familiar with the contents of lecture and tutorials. They can explain and apply them to new problems.		roblems.	
Skills	Is The students are able to design and evaluate a basic communications system. In particular, they can estimate the r			
		r. They are able to assess essential evaluation pa		asic communicatio
	system such as bandwidth efficiency or bit e	error rate and to decide for a suitable transmission	n method.	
Personal Competence				
Social Competence	The students can jointly solve specific prob	olems.		
Autonomy	The students are able to acquire relevan	nt information from appropriate literature source	ces. They can c	ontrol their level
	knowledge during the lecture period by solv	ving tutorial problems, software tools, clicker syste	em.	
Workload in Hours	Independent Chudu Time 110, Chudu Time in	a Laskura 70		
Credit points		1 Lecture 70		
Course achievement				
	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Specialisation Electrical Engine	ering: Compulsor	/
Following Curricula	Data Science: Core Qualification: Elective C			
5	Data Science: Specialisation I. Mathematics			
	Electrical Engineering: Core Qualification: C			
	Computer Science in Engineering: Core Qua			
	galance in Engineering, core qua			

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	 Introduction to communications engineering Open Systems Interconnection (OSI) reference model Components of a digital communications system Fundamentals of signals and systems
	 Principles of Analog-to-digital (A/D) conversion Deterministic and random signals
	Power and energy of signals Linear time-invariant (LTI) systems Quadrature amplitude modulation (QAM) Introduction to stochastics
	 Introduction to stochastics Probability theory Random experiments Probability model, probability space, sample space Definitions of probability
	 Probability according to Bernoulli/Laplace Probability according to van Mises, relative frequency Bertrand's paradox
	 Axiomatic definition of probability according to Kolmogorov Probability of disjoint and non-disjoint events Venn diagrams Continuous and discrete random variables

- Probability density function (pdf), cululative distribution function (cdf)
- Expected value, mean, median, quadratic mean, variance, standard deviation, higher moments
- Examples for probability distributions (Bernoulli distribution, two-point distribution, uniform distribution Gaussian (normal) distribution, Rayleigh distribution, etc.)
- Multiple random variables
 - Conditional probability, joint probability
 - Conditional and joint probability density function
 - Bayes' rule
 - Correlation coefficient
 - Two-dimensional Gaussian distribution
 - Statistically independent, uncorrelated and orthogonal random variables
 - Independent identically distributed (iid) random variables
 - Properties of expected value and variance
 - Covariance
 - Probability density function (pdf) and cumulative distribution function (cdf) of the sum of statistically independent random variables
 - Central limit theorem
- Probability density functions (pdfs) in data transmission
- Continuous-time and discrete-time random processes
 - Examples for random processes
 - Ensemble average and time average
 - Ergodic random processes
 - Quadratic mean and variance
 - Probability density function (pdf) and cumulative distribution function (cdf)
 - Joint probability density function (pdf) and joint cumulative distribution function (cdf)
 - Statistically independent, uncorrelated and orthogonal random processes
 - Stationary random processes
 - Correlation functions: Autocorrelation function, crosscorrelation function, average autocorrelation function of nonstationary random processes, autocorrelation and crosscorrelation function of stationary processes, autocovariance function, crosscovariance function
 - Autocorrelation matrix, crosscorrelation matrix, autocovariance matrix, crosscovariance matrix
 - Pseudo-noise sequences, example: Code division multiple access (CDMA)
 - Autocorrelation function, power spectral density (psd), signal power, Einstein-Wiener-Khintchine relations
 - White (Gaussian) noise
- Filtering of random processes by LTI systems
 - Transformation of the probability density function (pdf)
 - Transformation of the mean
 - Transformation of the power spectral density (psd)
 - Correlation functions of input and output signal
 - Filtering of white Gaussian noise
 - · Bandlimitation for noise power limitation
 - Preemphasis and deemphasis
- Companding, mu-law, A-law
- Functions of random variables
 - Transformation of probabilities and of the probability density function (pdf)
 - Application: Non-linear amplifiers
- Functions of two random variables
 - Probability density function
 - Examples: Rayleigh distribution, magnitude of an OFDM signal, magnitude of a received radio signal
- Transmission channels and channel models
 - Wireline channels: Telephone cable, coaxial cable, optical fiber
 - Wireless channels: Fading radio channel, underwater channels
 - Frequency-flat and frequency-selective channels
 - Additive white Gaussian noise (AWGN) channel
 - Signal to noise power ratio (SNR)
 - Discrete-time channel models
 - Discrete memoryless channels (DMC)
- Analog-to-digital conversion
 - Sampling
 - Sampling theorem
 - Pulse modulation
 - Pulse-amplitude modulation (PAM)
 - Pulse-duration modulation (PDM), pulse-width modulation (PWM)
 - Pulse-position modulation (PPM)
 - Pulse-code modulation (PCM)
 - Quantization
 - Linear quantizaton, midtread and midrise characteristic
 - Quantization error, quantization noise
 - Signal-to-quantization noise ratio
 - Non-linear quantization, compressor characteristics, mu-law, A-law
 - Speech transmission with PCM
 - Differential pulse-code modulation (DPCM)
 - Linear prediction according to the minimum mean squared error (MMSE) criterion.
 - DPCM with forward prediction and backward prediction
 - SNR gain of DPCM over PCM

	Delta modulation Fundamentals of information theory and coding
	Fundamentals of information theory and coding Definitions of information. Solf information, ontropy
	 Definitions of information: Self-information, entropy Binary entropy function
	Source coding theorem
	Source coding: Huffman code
	Mutual information and channel capacity
	 Channel capacity of the AWGN channel and the binary input AWGN channel
	Channel coding theorem
	 Principles of channel coding: Code rate and data rate, Hamming distance, minimum Hamming distance, error
	detection and error correction
	 Examples for channel codes: Block codes and convolutional codes, repetition code, single parity check code,
	Hamming code, Turbo codes
	Combinatorics
	Variation with and without repetition
	 Combination with and without repetition
	 Permutation, Permutation of multisets
	Word error probabilities of linear block codes
	Baseband transmission
	 Pulse shaping: Non-return to zero (NRZ) rectangular pulses, Manchester pulses, raised-cosine pulses, square-root
	raised-cosine pulses, Gaussian pulses
	 Transmit signal energy, average energy per symbol
	 Power spectral density (psd) of baseband signals
	 Definitions of signal bandwidth Bandwidth efficiency
	Intersymbol interference (ISI)
	 First and second Nyquist criterion
	• Eye patterns
	Receive filter design: Matched filter
	Matched-filter receiver and correlation receiver
	Square-root Nyquist pulse shaping
	Discrete-time AWGN channel model
	Maximum a posteriori probability (MAP) and maximum likelihood (ML) detection Bit error probability in AWCN chappeds for binary antipodal and on off signaling
	 Bit error probability in AWGN channels for binary antipodal and on-off signaling Band-pass transmission via carrier modulation
	Amplitude modulation, frequency modulation, phase modulation
	 Linear digital modulation methods: On-off keying (OOK), phase-shift keying (PSK), amplitude shift keying (ASK),
	quadrature amplitude shift keying (QAM)
	quadrature amplitude sinit keying (QAM)
	•
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner
Elterature	
	P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
	M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
	S. Haykin: Communication Systems. Wiley
	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Course L0443: Introduction t	ourse L0443: Introduction to Communications and Random Processes	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2354: Introduction t	ourse L2354: Introduction to Communications and Random Processes	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses						
Title				Тур	Hrs/wk	СР
EE Experimental Lab (L0781)				Practical Course	2	2
Measurements: Methods and Data	-			Lecture	2	3
Measurements: Methods and Data	Processing (L0780)			Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer	r				
Admission Requirements	None					
Recommended Previous	principles of mathematic	s				
Knowledge	principles of electrical en	gineering				
Educational Objectives	After taking part success	fully. students have	reached the following	a learning results		
Professional Competence	5 1 5 1 1 1 1 1 1	,,		5		
•	The students are able to	explain the purpose	e of metrology and t	he acquisition and proces	sing of measureme	ents. They can deta
	aspects of probability the	eory and errors, and	explain the processi	ng of stochastic signals. S	tudents know meth	nods to digitalize ar
	describe measured signa	ls.				
Skills	The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements.					
Personal Competence						
Social Competence	The students solve proble	ems in small groups.				
Autonomy	The students can reflect	their knowledge and	discuss and evaluat	e their results		
Autonomy	The students currencer	then knowledge und		e then results.		
Workload in Hours	Independent Study Time	110 Study Time in I	Locturo 70			
Credit points		110, Study Time in	Lecture 70			
•		orm	Description			
Course achievement		xcercises	Description			
Examination						
Examination duration and	90 min					
Examination duration and scale	50 11111					
	Conoral Engineering Colo	nco (Correspondence	m 7 comestarily C	ciplication Electrical English	ooring, Elective C-	mpulcon
-	General Engineering Scie			cialisation Electrical Engin	eering: Elective Co	mpulsory
Following Curricula	Electrical Engineering: Co			- Commulation		
	Engineering Science: Spe					
	Integrated Building Tech					
	Technomathematics: Spe	ecialisation III. Engine	eering Science: Elect	ive compulsory		

Course L0781: EE Experimen	ourse L0781: EE Experimental Lab			
Тур	Practical Course			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Alexander Schlaefer, Prof. Herbert Werner, Dozenten des SD E, Prof. Christian Becker, Prof. Heiko Falk, Prof. Bernd-Christian			
	Renner, Prof. Thorsten Kern, Prof. Alexander Kölpin			
Language	DE			
Cycle	WiSe			
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines			
Literature	Vird in der Lehrveranstaltung festgelegt			

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

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

Module M0760: Elect	onic Devices						
Courses							
Title			Тур	Hrs/wk	СР		
Electronic Devices (L0720)			Lecture	3	4		
Electronic Devices (L0721)	Prof. Hoc Khiem Trieu		Project-/problem-based Learning	2	2		
Module Responsible Admission Requirements	None						
Recommended Previous		one tomic model and quantum theory, electrical currents in solid state materials, basics in solid-state physics					
Knowledge	Cusesseful neuticipation of Dhusies for I	incineers and Material	a in Flactuical Engineering or course		ant contants		
	Successful participation of Physics for I	ingineers and Material	s in Electrical Engineering of course	s with equival	ent contents		
Educational Objectives	After taking part successfully, students	have reached the follo	owing learning results				
Professional Competence							
Knowledge							
	Students are able						
	 to represent the basics of semic 	onductor physics,					
	• to explain the operating principle	of important semicor	ductor devices				
	 to outline device characteristics 	and equivalent circuits	as well as to explain their derivation	on and			
	 to discuss the limitation of device 	e models.					
CL:II-							
Skills							
	Students are capable						
	 to apply devices in basic circuits 	,					
	 to realize the physical context a 	nd to solve complex pr	oblems by oneself				
Personal Competence							
Social Competence	Students are able to prepare and perfo	rm their lab experime	nts in team work as well as to pres	ent and discus	s the results in fro		
	of audience.						
Autonomy	Students are capable to acquire knowle		e in order to prepare their experim	ents.			
Workload in Hours	ndependent Study Time 110, Study Time	ne in Lecture 70					
Credit points Course achievement	ි Compulsory Bonus Form	Description					
course achievement	Yes 10 % Subject theor		den erarbeiten in Kleingruppen Wis	sen zu einem	bestimmten Them		
	practical work		eren dieses in Form eines Ve				
			n. Darüber hinaus betreut jede (Gruppe eine l	Ubungsaufgabe, d		
Examination	Written exam	minarulth	zu dem jeweiligen Versuch gehört.				
Examination duration and							
scale							
Assignment for the	General Engineering Science (German		Specialisation Electrical Engineerin	g: Compulsory	1		
Following Curricula	Electrical Engineering: Core Qualificatio						
	Engineering Science: Specialisation Ele General Engineering Science (English p			I: Compulsory			
	Computer Science in Engineering: Spec	-					

Course L0720: Electronic Dev	vices
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Hoc Khiem Trieu
Language	DE
Cycle	WiSe
Content	 Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor equations) pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode) Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor) Unipolar devices (surface effects: surface states, work function, energy band diagram; metal-semiconductor junctions: Schottky contact, current-voltage characteristics, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MOSFET: operating principle, depletion mode and enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics, frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS)
Literature	 S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011) T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004) B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005) D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011) M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996) S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007) H. Schaumburg: Halbleiter, B.G. Teubner (1991) A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992) HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

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

Courses								
Title		Тур	Hrs/wk	СР				
Semiconductor Circuit Design (L076	53)	Lecture	3	4				
Semiconductor Circuit Design (L086	54)	Recitation Section (small)	1	2				
Module Responsible	Prof. Matthias Kuhl							
Admission Requirements	None							
Recommended Previous	Fundamentals of electrical engineering							
Knowledge	Basics of physics, especially semiconducto	r physics						
		, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
	After taking part successfully, students have	ve reached the following learning results						
Professional Competence								
Knowledge	 Students are able to explain the fun 	ctionality of different MOS devices in electronic circ	cuits.					
		alog circuits functions and where they are applied.						
	• Students are able to explain the fun	ctionality of fundamental operational amplifiers an	d their specificati	ons.				
	 Students know the fundamental digitation 	tal logic circuits and can discuss their advantages	and disadvantage	es.				
	 Students have knowledge about me 	mory circuits and can explain their functionality ar	nd specifications.					
	 Students know the appropriate field 	s for the use of bipolar transistors.						
Skills	 Students can calculate the specifica 	tions of different MOS devices and can define the	parameters of ele	ctronic circuits.				
		nt logic circuits and can design different types of lo						
		rational amplifiers and bipolar transistors for specif						
Personal Competence								
Social Competence	 Students are able work officiently in 	hotorogonoous tooms						
	 Students are able work efficiently in Students working together in small 	groups can solve problems and answer professional	auestions					
	• Students working together in shun	groups can solve problems and answer professione	duestions.					
Autonomy								
	Students are able to assess their level of knowledge.							
Workload in Hours	Independent Study Time 124, Study Time	in Locture F6						
Credit points								
Course achievement								
Examination	Written exam							
Examination duration and	120 min							
scale								
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Electrical Engine	ering: Compulsory	ý				
Following Curricula	General Engineering Science (German	program, 7 semester): Specialisation Mechanica	al Engineering, I	Focus Mechatror				
	Compulsory							
	Data Science: Core Qualification: Elective O	1 2						
	Electrical Engineering: Core Qualification: 0							
	Engineering Science: Specialisation Electric							
	Engineering Science: Specialisation Mecha							
		ram, 7 semester): Specialisation Electrical Enginee						
		ram, 7 semester): Specialisation Mechatronics: Constitution II. Mathematics & Engineering Science: Elect						
	Mechanical Engineering: Specialisation Me	sation II. Mathematics & Engineering Science: Elect	uve compulsory					
	Mechatronics: Core Qualification: Compulsi							
	Technomathematics: Specialisation III. Eng	•						

	or Circuit Design
,.	Lecture
Hrs/wk	
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Matthias Kuhl
Language	
Cycle Content	SoSe
Content	Repetition Semiconductorphysics and Diodes
	Functionality and characteristic curve of bipolar transistors
	Basic circuits with bipolar transistors
	Functionality and characteristic curve of MOS transistors
	Basic circuits with MOS transistors for amplifiers
	Operational amplifiers and their applications
	Typical applications for analog and digital circuits
	Realization of logical functions
	Basic circuits with MOS transistors for combinational logic
	Memory circuits Basic circuits with MOS transistors for sequential logic
	Basic circuits with MOS transitions for sequencial logic Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496
	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S
	H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867
	URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499
	URL: http://dx.doi.org/10.1007/978-3-642-20887-4
	URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955
	URL: http://www.ciando.com/img/bo

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

Module M1693: Comp	uter Sci	ence f	or Engineers	- Programming	Concepts, Data Ha	ndling & Com	munication
Courses							
Гitle					Тур	Hrs/wk	СР
Computer Science for Engineers - P	rogramming	Concepts,	Data Handling & Cor	mmunication (L2689)	Lecture	3	3
Computer Science for Engineers - P	Programming	Concepts,	Data Handling & Cor	mmunication (L2690)	Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle	e Fröschle	2				
Admission Requirements	None						
Recommended Previous							
Knowledge							
Educational Objectives	After taking	g part suc	cessfully, students	have reached the follo	wing learning results		
Professional Competence							
Knowledge							
Skills							
Personal Competence							
Social Competence							
Autonomy							
Workload in Hours	Independer	nt Study T	Time 110, Study Tir	me in Lecture 70			
Credit points	6						
Course achievement	Compulsory		Form	Description			
		10 %	Attestation	Testate fin	den semesterbegleitend stat	t.	
Examination	Written exa	am					
Examination duration and	120 min						
scale			a :	-			
Assignment for the Following Curricula			g Science (Germa	n program, 7 semes	ter): Specialisation Mechan	ical Engineering, F	ocus Biomechanio
Following curricula	Compulsor		Science (Corman	aroaram 7 comostor):	Specialisation Biomedical Eng	ainooring: Compuls	251
					Specialisation Green Technol		
	Compulsor		Science (German)	orogram, 7 semester).	opecialisation oreen reenitor	ogies, i ocus iteriew	able Energy. Elect
			n Science (Germar	n program 7 semeste	r): Specialisation Mechanica	al Engineering Foc	us Energy System
	Compulsor		, (.,		
		ngineering		n program, 7 semeste	er): Specialisation Mechanica	al Engineering, Foo	us Aircraft Syster
				n program. 7 semes	ter): Specialisation Mechan	ical Engineering	Focus Mechatroni
	Compulsor			,		J	
			Science (German	program, 7 semester):	Specialisation Mechanical E	ngineering, Focus F	Product Developme
			tive Compulsory		•	5 5.	
	General En	gineering	Science (German	program, 7 semester):	Specialisation Electrical Engi	neering: Elective Co	mpulsory
					Specialisation Mechanical En		
	Engineering	g: Elective	e Compulsory				
			ing: Core Qualificat	ion: Compulsory			
	Chemical a	nd Biopro	cess Engineering:	Core Qualification: Com	npulsory		
	Electrical E	ngineerin	g: Core Qualificatio	n: Compulsory			
	Green Tech	nologies:	Energy, Water, Cli	mate: Specialisation Er	nergy Systems: Elective Com	pulsory	
	Logistics ar	nd Mobility	y: Specialisation In	formation Technology:	Compulsory		
	Mechatroni	cs: Core (Qualification: Comp	ulsory			
	Process En	gineering	: Core Qualification	: Compulsory			
	Engineering						

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

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

Module M0734: Electr	ical Engineering Project Labora	tory		
Courses				
Title Electrical Engineering Project Labo	ratory (L0640)	Typ Project-/problem-based Learning	Hrs/wk	CP 6
Module Responsible			0	0
Admission Requirements				
-	Electrical Engineering I, Electrical Engineering	1		
Knowledge				
Kilowicage				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the	e technical details of projects in the area of o	electrical engine	ering and illustrate
		describing and communicating relevant proble		
	technical language. They can explain the typic	al process of solving practical problems and pres	ent related resu	ilts.
Chille	The students can brancfor their fundamental	languiladan on electrical engineering to the pro-	eese of column	nunctical nuchlanas
SKIIIS		knowledge on electrical engineering to the pro luring the realization of projects in the context o		
	able to develop, compare, and choose concept		electrical engli	leering. Students are
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed	d-subject groups in order to independently deriv	e solutions to gi	ven problems in the
	context of electrical engineering. They are al	ole to effectively present and explain their resu	Ilts alone or in	groups in front of a
		lity to develop alternative approaches to a	an electrical e	ngineering problem
	independently or in groups and discuss advant	ages as well as drawbacks.		
Autonomy	Students are canable of independently solving	electrical engineering problems using provided	literature They	are able to fill gaps
Autonomy		literature and other sources provided by the		
		natically solve them by means of corresponding		
Workload in Hours	Independent Study Time 68, Study Time in Leo	ture 112		
Credit points	6			
Course achievement	None			
	Subject theoretical and practical work			
	based on task + presentation			
scale	Conoral Engineering Science (Correct and	7 competer), Specialization Flactrical Factor	na Compular	,
Assignment for the Following Curricula		n, 7 semester): Specialisation Electrical Engineer	ng: compuisory	
ronowing curricula	Engineering Science: Specialisation Electrical E			
	Engineering Science: Specialisation Electrical E			
	Technomathematics: Specialisation III. Engine			

Course L0640: Electrical Eng	ineering Project Laboratory
Тур	Project-/problem-based Learning
Hrs/wk	8
СР	6
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112
Lecturer	Prof. Christian Becker, Dozenten des SD E
Language	DE
Cycle	SoSe
Content	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.
Literature	Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).

Specialization Green Technologies

Module M1711: Green	n Technologies I				
	· · · · · · · · · · · · · · · · · · ·				
Courses					
Title		Тур	Hrs/wk	СР	
Introduction Green Technologies (L	2727)	Seminar	2	2	
Meteorology and Climate Systems	- Introduction (L2726)	Lecture	2	2	
Meteorology and Climate Systems	- Introduction (L2829)	Recitation Section (small)	2	2	
Module Responsible	Prof. Martin Kaltschmitt				
Admission Requirements	None				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results			
Professional Competence					
Knowledge	Upon completion of this module, students will be able to de	scribe and critically evaluate cu	Irrent environm	ental and climate	
	problems, especially in Hamburg. Furthermore, they are able to	find and process suitable appro	aches to solutio	ons. The students	
	can compare learned technologies in the field of climate and e	environmental protection, develo	p and take a st	andpoint on them	
	and defend it in discussions.				
	In addition, students can give an overview of the basics of meter	rology and climate.			
Skille	The students are able to apply the knowledge they have acquir	od on sustainable technologies i	n the area of th	o onvironmontally	
SKIIIS	and climate-friendly water, energy and climate nexus in order to				
	Furthermore, the students are able to explain the procedures a	nd basics on the topics of climate	e and meterolog	y and apply them	
	to renewable energy projects in the context of other modules.		5		
Personal Competence					
Social Competence	Students can				
	work together in a team of about 3-5 people,				
	 discuss tasks on the topics of environmental, resource and climate protection in a subject-specific manner and develop joint 				
	solutions,				
	present their own work results to fellow students and				
	assess the performance of fellow students in comparison to their own performance and deal with feedback on their own				
	performance.				
	<u>_</u> , , , , , , , , , , , , , , , , , , ,				
Autonomy	The students are able to independently access sources abour respective learning status in consultation with supervisors a				
	necessary to solve them.	na, on this basis, define fulthe	a questions and	a the work steps	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	Compulsory Bonus Form Description				
	Yes None Presentation				
Examination	Written exam				
Examination duration and	60 min				
scale					
Assignment for the	General Engineering Science (German program, 7 semester): Sp	ecialisation Green Technologies:	Compulsory		
Following Curricula	Green Technologies: Energy, Water, Climate: Core Qualification:	Compulsory			
	Orientation Studies: Core Qualification: Elective Compulsory				
Course L2727: Introduction C	Green Technologies				
Тур	Seminar				
Hrs/wk					

Тур	Seminar				
Hrs/wk	2				
СР					
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Martin Kaltschmitt, Dr. Marvin Scherzinger				
Language	DE				
Cycle	WiSe				
Content	 Preliminary discussion of the seminar Interesting presentations by people responsible for climate and environmental protection in Hamburg, keyword: Green Port of Hamburg Handing out of topics and tasks from the area of the seminar topic (green port of Hamburg) to individual students / groups of students (depending on the number of participating students Presentation of the task / the topic to be worked on with PPT presentation or poster presentation of the results 				
Literature	Eigenständiges Literaturstudium in der Bibliothek und aus anderen Quellen.				

Course L2726: Meteorology a	nd Climate Systems - Introduction
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dr. Stefan Bühler, Prof. Dr. Felix Ament
Language	DE
Cycle	WiSe
Content	The Earth's energy balance
	Conservation of energy, radiation, greenhouse effect, radiation balance, radiative forcing
	Local climate
	Energy balance at the surface, canopy effects (vegetation, city,), topography effects, evaporation, role of the pedosphere
	The water cycle
	Reservoirs of water, Clausius-Clapeyron, hydrological sensitivity, extreme precipitation
	The vertical structure of the atmosphere
	Hydrostatics, stability, spheres and pauses, radiative-convective equilibrium
	Clouds
	Life cycle of a cloud, from water vapour to precipitation
	A windy planet
	Pressure gradient force, Coriolis force, global wind system, turbulence and log. wind profile Wind profile
	Climate sensitivity
	Forcing-response approach, climate sensitivity, methods of determination, current knowledge
	Synoptics
	High and low pressure areas, air masses and fronts, instabilities
	Fast feedbacks in climate
	Water vapour, temperature gradient, ice albedo, clouds
	Weather and climate modelling
	Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parallel
	computers
	Carbon cycle and earth history
	Reservoirs of carbon, fossil fuels, earth ages, Urey reaction
	Weather extremes
	Rain, wind and heat - meteorological basics, statistical description & climate trends
	Ice and sea level
	Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles
	The view from space
Literature	Folien aus Vorlesung

Typ Recitation Section (small) Hrs/Wk 2 CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Dr. Stefan Bühler, Prof. Dr. Felix Ament Language DE Cycle Wifse Content The Earth's energy balance Conservation of energy, radiation, greenhouse effect, radiation balance, radiative forcing Local climate Energy balance at the surface, canopy effects (vegetation, city,), topography effects, evaporation, role of the pedosphere The water cycle Reservoirs of water, Clausius-Clapeyron, hydrological sensitivity, extreme precipitation The vertical structure of the atmosphere Hydrostatics, stability, spheres and pauses, radiative-convective equilibrium Clouds Life cycle of a cloud, from water vapour to precipitation A windy planet Pressure gradient force, Cariolis force, global wind system, turbulence and log. wind profile Wind profile Climate sensitivity Forcing-response approach, climate sensitivity, methods of determination, current knowledge Synoptics High and low pressure areas, air masses and fronts, instabilities Fast feedbacks in climate	Course L2829: Meteorology a	and Climate Systems - Introduction
CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Dr. Stefan Bühler, Prof. Dr. Felix Ament Language DE Cycle WiSe Content The Earth's energy balance Conservation of energy, radiation, greenhouse effect, radiation balance, radiative forcing Local climate Energy balance at the surface, canopy effects (vegetation, city,), topography effects, evaporation, role of the pedosphere The water cycle Reservoirs of water, Clausius-Clapeyron, hydrological sensitivity, extreme precipitation The vartical structure of the atmosphere Hydrostatics, stability, spheres and pauses, radiative-convective equilibrium Clouds Life cycle of a cloud, from water vapour to precipitation A windy planet Pressure gradient force, Coriolis force, global wind system, turbulence and log. wind profile Wind profile Climate sensitivity Forcing-response approach, climate sensitivity, methods of determination, current knowledge Synoptics High and low pressure areas, air masses and fronts, instabilities Fast feedbacks in climate Water vapour, temperature gradient, ice albedo, clouds Westher and climate modelling Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parall computers <th>Тур</th> <th>Recitation Section (small)</th>	Тур	Recitation Section (small)
Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecture Prof. Dr. Stefan Bühler, Prof. Dr. Felix Ament Language DE Cycle WiSe Content The Earth's energy balance Conservation of energy, radiation, greenhouse effect, radiation balance, radiative forcing Local climate Energy balance at the surface, canopy effects (vegetation, city,), topography effects, evaporation, role of the pedosphere The water cycle Reservoirs of water, Clausius-Clapeyron, hydrological sensitivity, extreme precipitation The vertical structure of the atmosphere Hydrostatics, stability, spheres and pauses, radiative-convective equilibrium Clouds Life cycle of a cloud, from water vapour to precipitation A windy planet Pressure gradient force, Coriolis force, global wind system, turbulence and log. wind profile Wind profile Climate sensitivity Forcing response approach, climate sensitivity, methods of determination, current knowledge Synoptics High and low pressure gradient, ice albedo, clouds Weather and climate modelling Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parall computers Carbon cycle and earth history Reservoirs of carbon, fossil fuels, earth ages, Urey reaction <tr< th=""><th>Hrs/wk</th><th>2</th></tr<>	Hrs/wk	2
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Cycle WiSe Content The Earth's energy balance Conservation of energy, radiation, greenhouse effect, radiation balance, radiative forcing Local climate Energy balance at the surface, canopy effects (vegetation, city,), topography effects, evaporation, role of the pedosphere The water cycle Reservoirs of water, Clausius-Clapeyron, hydrological sensitivity, extreme precipitation The vertical structure of the atmosphere Hydrostatics, stability, spheres and pauses, radiative-convective equilibrium Clouds Life cycle of a cloud, from water vapour to precipitation A windy planet Pressure gradient force, Coriolis force, global wind system, turbulence and log. wind profile Wind profile Climate sensitivity Forcing-response approach, climate sensitivity, methods of determination, current knowledge Synoptics High and low pressure areas, air masses and fronts, instabilities Fast feedbacks in climate Water vapour, temperature gradient, ice albedo, clouds Weather and climate modelling Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parall computers Carbon cycle and earth history Reservoirs of carbon, fossil fuels, earth ages, Urey reaction Weather extremes Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Miankovitch cycles	Lecturer	Prof. Dr. Stefan Bühler, Prof. Dr. Felix Ament
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Weather and climate modelling Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parall computers Carbon cycle and earth history Reservoirs of carbon, fossil fuels, earth ages, Urey reaction Weather extremes Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Fast feedbacks in climate
Discretisation and num. Solution, parametrisation, data assimilation, boundary conditions, ensemble predictions, chaos, parall computers Carbon cycle and earth history Reservoirs of carbon, fossil fuels, earth ages, Urey reaction Weather extremes Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Water vapour, temperature gradient, ice albedo, clouds
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Reservoirs of carbon, fossil fuels, earth ages, Urey reaction Weather extremes Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		computers
Weather extremes Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Carbon cycle and earth history
Rain, wind and heat - meteorological basics, statistical description & climate trends Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Reservoirs of carbon, fossil fuels, earth ages, Urey reaction
Ice and sea level Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Weather extremes
Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles		Rain, wind and heat - meteorological basics, statistical description & climate trends
		Ice and sea level
The view from space		Is the sea level rising? Role of ice in Earth's history, snowballs and greenhouses, Milankovitch cycles
		The view from space
Literature Folien aus Übung	Literature	Folien aus Übung

Courses						
Title			Тур	Hrs/wk	СР	
Practical Course Measurement Technology (L2270)			Practical Course	2	2	
Measurement Technology (L2268)			Lecture	2	2	
Physical Fundamentals of Measure	ment Technology (L	2269)	Lecture	2	2	
Module Responsible	Prof. Alexander P	rof. Alexander Penn				
Admission Requirements	None					
Recommended Previous Knowledge		t, logical skills, integral-	and differential calculus, basic physical cor	ncepts such as tempera	iture, mass, veloci	
Educational Objectives	After taking part	successfully, students ha	ave reached the following learning results			
Professional Competence						
Knowledge	-		ics (theory of motion), rotation of rigid t nperature and heat, ideal gas.	podies, energy and mo	omentum, electric	
			neasurement uncertainty, basics of sensor t vel measurement, flow measurement. Usage		nciples, temperatu	
			calorimetry, image data acquisition, flow me of solid concentrations, spectroscopy, error c			
Skills	Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, fi programming with Matlab, use of relevant laboratory measurement technology, preparation of a test protocol, execution calculations.					
Personal Competence						
Social Competence	experimental sta		ctical training and learning groups, assessm tion with persons responsible for teachir			
Autonomy	protective equip		pendent development of the thematic basic g, practice of presentation in front of a is by using clicker.			
Workload in Hours	Independent Stu	dy Time 96, Study Time i	n Lecture 84			
Credit points	6					
Course achievement	CompulsoryBonusNo20 %		Description Popup-Quizzes währen der Vorlesu	ng		
Examination	Written exam					
Examination duration and	120 min					
scale						
	_		ogram, 7 semester): Specialisation Process E			
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory					
	Bioprocess Engineering: Core Qualification: Compulsory					
	Chemical and Bioprocess Engineering: Core Qualification: Compulsory					
	Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory					
	Orientation Studies: Core Qualification: Elective Compulsory Process Engineering: Core Qualification: Compulsory					

ourse L2270: Practical Course Measurement Technology						
Тур	Practical Course					
Hrs/wk	2					
СР						
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28					
Lecturer	Prof. Alexander Penn					
Language	DE					
Cycle	WiSe					
	In the Practical Course in Measurement Technology the theory from the lectures "Physical Fundamentals of Measurement Technology" and "Measurement Technology" will be applied in practice. In small groups students learn how to handle different measurement techniques from industry and research. During the practical course, a wide range of different measurement methods will be taught, including the use of HLPC columns for qualitative mass analysis, the determination of mass transfer coefficients using optical oxygen sensors or the evaluation of image data to obtain process parameters. The practical course also teaches how measurement data are statistically evaluated and experiments are correctly documented.					
Literature	 Hug, H.: Instrumentelle Analytik. Theorie und Praxis. Verlag Europa-Lehrmittel, Haan-Gruiten, 2015. Kamke, W.: Der Umgang mit experimentellen Daten, insbesondere Fehleranalyse, im physikalischen Anfänger-Praktikum. Eine elementare Einführung. W. Kamke, Kirchzarten [Keltenring 197], 2010. Strohrmann, G.: Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. Oldenbourg, München, 2004. 					

Course L2268: Measurement	Technology
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Penn
Language	DE
Cycle	WiSe
Content	Basic introduction to measurement technology for process engineers. Includes error calculation, measurement units, calibration, measurement data analysis, measurement techniques and sensors. Particular attention is paid to the measurement of temperature, pressure, flow and level. The lecture provides insights into the latest developments in sensor technology in measurement technology and process engineering.
Literature	 Fraden, Jacob (2016): Handbook of Modern Sensors. Physics, Designs, and Applications. 5th ed. 2016. Cham, New York: Springer. Online verfügbar unter http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&AN=1081958. Hering, Ekbert; Schönfelder, Gert (2018): Sensoren in Wissenschaft und Technik. Funktionsweise und Einsatzgebiete. 2. Aufl. 2018. Online verfügbar unter http://dx.doi.org/10.1007/978-3-658-12562-2. Strohrmann, Günther (2004): Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. 10., durchges. Aufl. München: Oldenbourg. Tränkler, Hans-Rolf; Reindl, Leonhard M. (2014): Sensortechnik. Handbuch für Praxis und Wissenschaft. 2., völlig neu bearb. Aufl. Berlin: Springer Vieweg (VDI-Buch). Online verfügbar unter http://dx.doi.org/10.1007/978-3-642-29942-1. Webster, John G.; Eren, Halit B. (2014): Measurement, Instrumentation, and Sensors Handbook, Second Edition. Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement. 2nd ed. Hoboken: Taylor and Francis. Online verfügbar unter http://gbv.eblib.com/patron/FullRecord.aspx?p=1407945.

Course L2269: Physical Fund	Course L2269: Physical Fundamentals of Measurement Technology				
Тур	Lecture				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Christian Schroer				
Language	DE				
Cycle	WiSe				
Content	Classical mechanics - kinematics, dynamics, energy, momentum and conservation laws, rigid bodies, translation and rotation, angular momentum. Mechanics of gases and fluids - hydrostatics and hydrodynamics Thermodynamics - temperature, heat, heat transport, ideal gas, changes of state, cyclic processes, laws of thermodynamics Electricity - electrostatics, electrical conduction, magnetism, Lorentz force, Maxwell's equations (integral form)				
Literature	Paul A. Tipler, Gene Mosca: Physik für Wissenschaftler und Ingenieure, Spektrum Verlag D. Meschede (Hrsg.): Gerthsen Physik, Springer-Verlag Jay Orear: Physik, Hanser Verlag D. Halliday, R. Resnick, J. Walker: Physik, Wiley VCH				

<u>.</u>						
Courses						
Title		Тур		Hrs/wk	СР	
Fundamentals of Fluid Mechanics (Lecture		2	2	
Fundamentals on Fluid Mechanics			on Section (small)	2	2	
Fluid Mechanics for Process Engine		Recitation	on Section (large)	2	2	
Module Responsible						
Admission Requirements	None					
Recommended Previous	Mathematics I+II+III					
Knowledge	Technical Mechanics I+II					
	Technical Thermodynamics I+I					
	Working with force balances					
	 Simplification and solving of pa 	tial differential equations				
	Integration					
Educational Objections		- hanne waarde al blaa fallon die en laaren				
	After taking part successfully, student	s nave reached the following learni	ng results			
Professional Competence	Students are able to:					
Knowleage	Students are able to:					
	 explain the difference between 	different types of flow				
	 give an overview for different a 	pplications of the Reynolds Transpo	ort-Theorem in proce	ess engineering		
	• explain simplifications of the C	ntinuity- and Navier-Stokes-Equati	on by using physical	boundary conditi	ons	
Skills	The students are able to					
Skiiis	The students are able to					
	describe and model incompressible flows mathematically					
	 reduce the governing equation 	of fluid mechanics by simplificatio	ns to archive quantit	tative solutions e.	g. by integration	
		theory and technical applications				
	 use the learned basics for fluid 	dynamical applications in fields of	process engineering			
Personal Competence						
Social Competence	The students					
	• are capable to gather informat	on from subject related profession	al publications and	rolate that inform	ation to the contr	
	• are capable to gather informat	on from subject related, professior				
		ct related tasks in small groups. T	hev are able to pres	ent their results a	effectively in Engli	
	 able to work together on subject related tasks in small groups. They are able to present their results effectively in Englis (e.g. during small group exercises) 					
		or exercises by themselves, to disc	uss the solutions ora	Ilv and to present	the results.	
				,		
Autonomy	The students are able to					
	 search further literature for each 	h topic and to expand their knowle	dge with this literatu	ire.		
		own and to evaluate their actual k	-			
	-					
	Independent Study Time 96, Study Tin	ne in Lecture 84				
Credit points						
Course achievement	Compulsory Bonus Form No 5 % Midterm	Description				
Examination	Written exam					
Examination duration and						
scale						
Assignment for the	General Engineering Science (Germar	program, 7 semester): Specialisati	ion Green Technolog	ies: Compulsory		
Following Curricula	General Engineering Science (German				pulsory	
	Bioprocess Engineering: Core Qualific					
	Chemical and Bioprocess Engineering	Core Qualification: Compulsory				
	Green Technologies: Energy, Water, C	limate: Core Qualification: Compuls	sory			
	Integrated Building Technology: Core	Qualification: Compulsory				
	Logistics and Mobility: Specialisation	raffic Planning and Systems: Electi	ve Compulsory			
	Technomathematics: Specialisation III	Engineering Science: Elective Con	npulsory			
	Process Engineering: Core Qualification	n: Compulsory				
	Engineering and Management - Major	a tradiction and Malalita Constalled	tion Treeffic Discussion	and Contained Fla		

Course L0091: Fundamentals	of Fluid Mechanics
Тур	Lecture
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	 fluid properties hydrostatic overall balances - theory of streamline overall balances - conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Falg / 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 L2933: Fundamentals	s on Fluid Mechanics
Тур	Recitation Section (small)
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 group exercise, the contents of the lecture are taken up and deepened by means of exercises. The exercise tasks correspond in quality and scope to the tasks of the written exam. Topics: Reynolds transport-theorem, pipe flow, free jet, angular momentum, Navier-Stokes equations, potential theory, mock exam, pipe hydraulics, pump design.
Literature	Heinz Herwig: Strömungsmechanik, Eine Einführung in die Physik und die mathematische Modellierung von Strömungen, Springer Verlag, Berlin, 978-3-540-32441-6 (ISBN) Herbert Oertel, Martin Böhle, Thomas Reviol: Strömungsmechanik für Ingenieure und Naturwissenschaftler, Springer Verlag, Berlin, ISBN: 978-3-658-07786-0 Joseph Spurk, Nuri Aksel: Strömungslehre, Einführung in die Theorie der Strömungen, Springer Verlag, Berlin, ISBN: 978-3-642- 13143-1.

Course L0092: Fluid Mechani	Recitation Section (large)		
Hrs/wk			
СР			
	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. Paralle 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 Strömungsvorgånge dichtebeständiger Fluide. Springer- Verlag, Berlin, Heidelberg, 2008 		
	 Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011 		

Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy markets and energy trading	J (L2744)	Lecture	2	2
Fossil Energy Systems (L2745)		Lecture	2	2
ossil Energy Systems (L2746)		Recitation Section (large)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Skills	explain the issues that arise. Furthermore, they are able to explain knowledge of energy production, energy distribution ar energy trade in this context, taking into account contexts bordering on other disciplines. The students can explain this knowledg which is applicable to almost all energy systems, in particular detail for conventional energy systems and take a critical stance of them. Furthermore, they can explain the environmental impact of using conventional energy systems. They also have an overviee of reserves and resources as well as global and national market volumes. This also includes the legal framework, which shou especially take into account the mitigation of climate change. Students are able to apply methodologies for determining energy demand or energy supply to different types of energy system Furthermore, they can evaluate energy systems technically, ecologically and economically as well as systemically and are alse able to design them under certain given conditions. They are able to select the regulations necessary for this in a subject-specifi manner, especially by means of non-standard solutions to a problem. Students are able to orally explain issues from the subject area and approaches to dealing with them and to classify them in the respective context.			
Personal Competence				
	criteria under sustainability aspects. Students can independently exploit so	table technical alternatives and to assess them wi ources , acquire the particular knowledge about th		-
	questions.			
Workload in Hours	Independent Study Time 96, Study Tim	ie in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
	General Engineering Science (German	program, 7 semester): Specialisation Green Techno	logies: Compulsorv	
scale Assignment for the Following Curricula		program, 7 semester): Specialisation Green Techno program, 7 semester): Specialisation Green Techno		

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

Course L2744: Energy marke	ts and energy trading
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Wulf
Language	DE
Cycle	SoSe
Content	This lecture addresses the mechanisms by which price formation works in global and national energy markets. For this purpose, the global price formation mechanism for crude oil and for natural gas and coal is explained. The national energy markets (e.g. power exchange, gas markets) are also discussed. The legal framework, which is ultimately decisive for market price formation, is always addressed. In this context, the various instruments with which the energy markets are to be influenced in such a way that climate protection already takes effect with market-based measures are also discussed. The expected future development/change of the energy markets against the background of the increasing use of renewable energies will also be addressed.
Literature	

Course L2745: Fossil Energy	Systems
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	The aim of this lecture is to present and discuss the different fossil energy systems in their entirety. This includes the petroleum, natural gas, hard coal, lignite and nuclear energy systems. In each case, the formation processes, the exploration technologies, the exploration processes, the extraction technologies, the further processing processes and the corresponding utilization are presented. In addition, the respective markets and their development, the existing reserves and resources, and the environmental effects associated with extraction and utilization are discussed. A total system approach is pursued, which includes a presentation of the entire energy system including the given interdependencies and (geo)political dependencies. The current changes in these energy systems for Germany and internationally, and those that are expected in the coming years, are also discussed. In addition, the respective reserve and resource availability is illuminated.
Literature	Vorlesungsunterlagen

Course L2746: Fossil Energy	Systems
	Recitation Section (large)
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	The goal of this exercise is to present and discuss the different fossil energy systems in their entirety. This includes the petroleum, natural gas, hard coal, lignite and nuclear energy systems. In each case, the formation processes, the exploration technologies, the exploration processes, the extraction technologies, the further processing processes and the corresponding utilization are presented. In addition, the respective markets and their development, the existing reserves and resources, and the environmental effects associated with extraction and utilization are discussed. A total system approach is pursued, which includes a presentation of the entire energy system including the given interdependencies and (geo)political dependencies. The current changes in these energy systems for Germany and internationally, and those that are expected to occur in the coming years, are also discussed. In addition, the respective reserve and resource availability is illuminated.
Literature	Unterlagen des Übung

Courses				
ītle		Тур	Hrs/wk	СР
Renewable Energies I (L2740)		Lecture	2	2
Renewable Energies I (L2742)		Recitation Section (large)	1	1
Renewable Energies II (L2741)		Lecture	2	2
Renewable Energies II (L2743)		Recitation Section (large)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
•	None			
	none			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Upon completion of this module, studen	ts will be able to provide an overview of characteris	stics of renewable e	energy systems. T
	will be able to explain the issues that a	arise in these systems. Furthermore, they are able	to explain knowled	lge of energy sup
	energy distribution and energy trading	in this context, taking into account contexts border	ing on specific disc	ciplines. The stude
	can explain this knowledge in detail for	r such energy systems and take a critical stand o	n it. Furthermore,	they can explain
	environmental impact of using renewal	ole energy systems and have an overview of the e	conomic classificat	tion of the respec
	options.			
CI:!!!-		- for determining a construction of the second s	the difference being a	- f
		es for determining energy demand or energy suppl		
	systems. Furthermore, they can evaluate such energy systems technically, ecologically and economically as well as systemical			
		en conditions. They are able to select the regulation	is necessary for thi	s in a subject-spe
	manner, especially by means of non-sta	indard solutions to a problem.		
	Students are able to orally explain issu	es from the subject area and approaches to dealin	g with them and to	classify them in
	respective context.		5	
Personal Competence				
Social Competence	Students are able to investigate suitab	le technical alternatives and ultimately evaluate t	hem based on tec	hnical, economic
	ecological criteria - and thus from a sus	tainability perspective.		
Autonomy	Students will be able to independently a	access sources about the field, acquire knowledge a	nd transform it to a	address new issue
	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement Examination	Written exam			
Examination duration and				
scale	50 11111			
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Green Technol	ogies: Compulsory	
Following Curricula	General Engineering Science (German p	program, 7 semester): Specialisation Green Technol	ogies: Compulsory	
-		pecialisation Civil Engineering: Elective Compulsory		
		pecialisation Traffic and Mobility: Elective Compulso		
		pecialisation Water and Environment: Elective Com		
		Specialisation Chemical Engineering: Compulsory		
	Green Technologies: Energy, Water, Clir			
	Siecei i connologico. Energy, Water, em	nater core qualification, compaisory		

Course L2740: Renewable Energies I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE	
Cycle	SoSe	
Content	This module includes a presentation of the renewable energy supply and a discussion of the respective technologies for providing the desired final or useful energy. Specifically, this includes the options for solar energy use for heat and power generation (i.e., passive solar energy use, solar collectors for low-temperature heat provision, solar thermal power generation, photovoltaic power generation), wind energy use for power generation (i.e. onshore and offshore wind power use), hydroelectric power use for electricity generation (i.e., run-of-river and storage hydroelectric power), ocean energy use for electricity generation (including tidal power plants), and geothermal energy use for heat and electricity generation (i.e., near-surface use by means of heat pumps, deep geothermal energy use for heat and/or electricity generation).	
Literature	Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2020, 6. Auflage	

Course L2742: Renewable Er	ergies I
Тур	Recitation Section (large)
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	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are:
	 Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2020, 6. Auflage

Course L2741: Renewable En	ergies II
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
	This lecture covers all options for energy supply from biomass; this includes the supply of heat, electricity and fuels. The biomass resource and its origin will be discussed first. Afterwards the biomass supply is addressed, which bridges the gap between biomass generation and utilization. Subsequently, the different conversion options are discussed. Only those options are presented in depth that have a corresponding significance on the market in Germany and Europe. This includes (a) heat generation from biogenic solid fuels in small and large-scale plants (b) power generation from solid biomass via combustion (c) a biogas production from residues, by-products and waste, (d) alcohol production from sugar and starch (e) biodiesel production from vegetable oils. Special attention is also paid to the corresponding environmental aspects. An economic classification of the various options is also provided.
Literature	Unterlagen der Vorlesung

Course L2743: Renewable Energies II		
Тур	Recitation Section (large)	
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	The students work on tasks in the field of renewable energies the field "energy from biomass". They present their solution approaches in the exercise group and discuss them with their fellow students and the teaching staff afterwards.	
Literature	Unterlagen der Vorlesung	

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

	ary Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Wastewater Disposal (L0276)		Lecture	2	2
Wastewater Disposal (L0278)		Recitation Section (large)	1	1
Drinking Water Supply (L0306)		Lecture	2	1
Drinking Water Supply (L0308)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge on Chemistry and	Biology		
Knowledge	 Hydraulics of pipe systems and op 			
		ement: water quantity and water quality		
	Basic knowledge on Environmenta			
	Basic knowledge on Environmenta	r Legislation. Federal Water Act		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students can examplify their expert	knowledge on urban water infrastructures. They	can present the de	erivation and detail
	explanation of important standards for th	ne design of drinking water supply and wastewate	er disposal systems	in Germany and th
	are capable of reproducing the relevant	empiricals assumptions and scientific simplifcation	ns. The students ar	e able to present a
	discuss sanitary engineering processes	and the technologies used for drinking and was	ewater treatment.	They can also ass
	existing problems in the field of sanitary	engineering by considering legal, risk and saftey	aspects. Furthermo	ore, they know how
	draft the features and effectiveness of in	mportant technologies of the future such as hig	h- and low-pressure	e membrane filtrat
	systems and techniques for the removal	of trace pollutants.		
Skills	The students are able to apply the relev	ant standards and guidelines for the design and	operation of urban	water infrastructu
	independently. Their expertise comprises	s expert skills to design drinking water supply an	d urban drainage sy	stems as well as t
	associated treatment facilities. Besides t	he acquirement of technical skills the students a	re able to address a	and solve biochemi
	problems in the filed of drinking water	and wastewater treatment. The students are al	so able to develop	ideas of their own
	improve the existing water related infras	tructures, systems and concepts.		
Personal Competence				
Social Competence	Social skills are not targeted in this modu	ıle.		
Autonomy	Students are able to form concents on	their own to optimize urban water infrastructur	processes Thorat	foro thoy can acqu
Autonomy		in some clues or information with regard to the		
	follow-up of the exercises).	in some clues of information with regard to the		
	follow-up of the exercises).			
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Green Techno	logies: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Co	re Qualification: Compulsory		
	Green Technologies: Energy, Water, Clim	ate: Core Qualification: Compulsory		
	Integrated Building Technology: Core Qui	alification: Compulsory		

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

Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	This lecture focusses on urban drainage and wastewater treatment.
	Urban Drainage
	 Design of urban drainage systems (combined and separate sewer systems)
	Special structures
	Rainwater management
	Wastewater treatement
	 Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membra Filtration)
	Biological Treatment (aerobic, anaerobic, anoxic)
	Special Wastewater Treatment Processes (Ozonation, Adsorption)
Literature	Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.
	The literature listed below is available in the library of the TUHH.
	 Taschenbuch der Stadtentwässerung : mit 10 Tafeln und 67 Tabellen, Imhoff, K., & . (2009). (31., verbesserte Aufl München: Oldenbourg Industrieverl.
	 Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998.
	 Kommunale Kläranlagen : Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Günthert, F. Wolfgang: völlig neu bearb. Aufl.). Renningen: expert-Verl.
	 Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Educat 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 D	Course L0278: Wastewater Disposal	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Course L0308: Drinking Wate	ourse 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 Manual B.Sc. "General Engineering Science (German program, 7 semester)"

occur from production processes, projects or construction measures. They have knowledge about the methodological diversity					
Pacinal service nervicemental Technology (1387) Practical course 1 1 Swiremental Technologie (10920) Lecture 2 3 Swiremental Technologie (10920) Lecture 2 2 Module Responsible Dr. Marvin Scherzinger Admission Requirements None Recommended Previous Fundamentals of inorganic/organic chemistry and biology. Knowledge Fundamentals of inorganic/organic chemistry and biology. Knowledge Admission Requirements None S S Professional Competence Knowledge Additional students acquire indepth knowledge of important cause-effect chains of potential environmental problems which mi occur from production processes, projects or construction measures. They have knowledge adbut the methodological diversity, are competent in dealing with different intendos an instruments to assesse the potential or potiatents are able to assess the potential or molitatents are able to explore any or the security of assessment methods in methodia provinomental impacts. Exelses the students are able to explore any or students are able to assess the potential or evironmental problems. They are able to a conservinomental indepts. They are able to accur from production processes, projects or construction measures for environmental indepts. They are able to accur from production processes, projects or construction measures for environmental indepts. They are able to accur from production processes, projects or construction approducti dealinge on the students are able to	Courses				
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Credit points 6 Course achievement None Examination Written exam Examination duration and scale 120 min	Autonomy			-	
Credit points 6 Course achievement None Examination Written exam Examination duration and scale 120 min	Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Course achievement None Examination Written exam Examination duration and scale 120 min					
Examination duration and 120 min					
scale	Examination	Written exam			
	Examination duration and	120 min			
Assignment for the General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory	scale				
	Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Green Techno	logies: Compulsory	

Course L1387: Practical Exer	cise Environmental Technology
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt, Dr. Marvin Scherzinger
Language	DE
Cycle	SoSe
Content	The practical course Environmental Engineering currently consists of 5 experiments, which deal with the different focal points of
	environmental engineering in the areas of air, water, soil, energy and noise. The following experiments are carried out for this
	purpose:
	biological degradation of artificial materials,
	fine dust measurement in the air,
	water analysis,
	noise emission measurement,
	photovoltaic energy
	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	Folien der Einführungsveranstaltung

Course L2996: Pollutant ana	urse L2996: Pollutant analysis	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Marvin Scherzinger	
Language	DE	
Cycle	WiSe	
Content	In this course, modern analytical methods are presented that are used for the quantification of pollutants in the environmental compartments soil, water and air. In doing so, the students deepen their theoretical knowledge with regard to working with standardized methods and learn to make statements about the quality of test results.	
Literature	Vorlesungsfolien	

Course L0326: Environmenta	l Technologie
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, Dr. Marvin Scherzinger
Language	DE
Cycle	WiSe
Content	 Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)
Literature	r ofster, G., Ontweltschutzteenink, 2012, Springer benin (Venag) G., Aufi. 2012, 576-5-042-22572-5 (ISBN)

Courses				
Courses				
Title		Тур	Hrs/wk	CP
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	Z
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge				
	 The students are capable of explaining qualitative heat exchanger, chemical reactors). They are capable of distinguish and characterize of transfer and thermal radiation. The students have the ability to explain the prince qualitative and quantitative by using suitable mass. They are able to depict the analogy between heat. 	different kinds of heat transfer mech nysical basis for mass transfer in c s transfer theories.	anisms namely h letail and to de:	neat conduction, h
Skills	 The students are able to set reasonable system I and to balance the corresponding energy and mass They are capable to solve specific heat transfer p and to calculate the corresponding heat flows. Using dimensionless quantities, the students can eta able to distinguish between diffusion, co for the description and design of apparatus (e.g. e In this context, the students are capable to choose application considering their advantages and disact In addition, they can calculate both, steady-state at The students are capable to connect their know particular the courses thermodynamics, fluid meta problems. 	is flow, respectively. problems (e.g. heated chemical reac execute scaling up of technical proce nvective mass transition and mass t xtraction column, rectification colum e and design fundamental types of he dvantages, respectively. and non-steady-state processes in pro pwledge obtained in this course w	tors, temperatur sses or apparatu ransfer. They car n). eat and mass exc ocedural apparat vith knowlegde	e alteration in flui s. n use this knowlec changer for a spec cus. of other courses
Personal Competence Social Competence	 The students are capable to work on subject-spec manner to tutors and other students. 	ific challenges in teams and to pres	ent the results o	orally in a reasona
Autonomy	 The students are able to find and evaluate necess. They are able to prove their level of knowledge system, exam-like assignments) and on this basis 	during the course with accompany	ying procedure of	continuously (click
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination				
Examination duration and	120 minutes; theoretical questions and calculations			
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Green Technolog	ies: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semes	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 semes			npulsory
	Bioprocess Engineering: Core Qualification: Compulsory		J	, ,
	Chemical and Bioprocess Engineering: Core Qualification	Compulsory		
	Energy and Environmental Engineering: Core Qualificatio			
	Green Technologies: Energy, Water, Climate: Core Qualif			
	Technomathematics: Specialisation III. Engineering Scien	ce: Elective Compulsory		

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

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

Course L1868: Heat and Mas	is 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

Focus Renewable Energy

Module M1713: Greer	n Technologies III				
Courses					
Title		Тур	Hrs/wk	CP	
Study Work Green Technologies (L2		Project Seminar	2	4 2	
Scientific Work and Writing (L2765)		Seminar	Z	2	
	Dozenten des Studiengangs				
Admission Requirements					
Recommended Previous	keine				
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	The students, based on a literature survey,	learn to study in detail a subject theme from	n the disciplines of gro	een technologies a	
	deliver afterwards a summary presentation	to a specialised audience. Environmental iss	ues and their multidis	ciplinary linkages a	
	preferred, when selecting the thematic area	a of these studies. Through their own written	contribution the stude	ents communicate	
		echnical writing. With the discussion the s	tudents practice scie	entific debating on	
	specialised subject matter.				
Skills	The students can, when working on a techni	ical tonic not familiar to them:			
JKIIIS	The students call, when working of a techni	to them.			
	 conduct a literature survey 				
	choose the relevant information for th	heir presentation			
	prepare a written summary				
	present results in front of peers and staff				
	 correctly cite and reference sources. 				
Demonstration of the second second					
Personal Competence			Alexandre and Leaves have		
Social Competence			-		
	their own technical sub-topic tailored to their public and discuss with the audience. When attending technical presentations, th students can formulate questions to other speakers and participate in the ensuing discussion.				
	students can formulate questions to other s	peakers and participate in the ensuing discu	551011.		
	The fulfilment of the tasks combines indepe	ndent work with group and teamwork.			
				_	
Autonomy	The students can, guided by instructors, crit	tically reflect on their learning and work state	is, and write a scientif	fic report.	
Workload in Hours	Independent Study Time 124, Study Time in	1 Lecture 56			
Credit points					
Course achievement					
Examination	Study work				
Examination duration and	2				
Examination duration and scale					
			- Indian France P	able Francis Fl. 11	
Assignment for the		ram, 7 semester): Specialisation Green Tech	iologies, Focus Renew	able Energy: Electi	
Following Curricula	Compulsory	ware 7 compositor). Crossiplication Correct Table	nelegies Feele Mat-	r and Environment	
		ram, 7 semester): Specialisation Green Tech	inologies, Focus Wate	r and Environment	
	Engineering: Elective Compulsory	- Chapteling Engrand Technology Chapter	Campaulaar		
		e: Specialisation Energy Technology: Elective	compulsory		
	Green Technologies: Energy, Water, Climate				
		e: Specialisation Energy Systems: Elective Co	mpulsory		
		e: Specialisation Bioresource Technology: Ele			

Course L2766: Study Work G	reen Technologies
Тур	Project Seminar
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dozenten des Studiengangs
Language	DE
Cycle	WiSe
Content	Students carry out a research project in a scientific field under the guidance of an academic staff member. For this purpose, the student can approach the staff of the respective institute and discuss a topic. The topic is then worked on within 4 weeks and regular consultations are held with the supervisor. The student research project should be the size of a scientific article.
Literature	

Typ Sc Hrs/wk 2 CP 2 Workload in Hours In Lecturer Do Cycle W Content Th in m To
CP 2 Workload in Hours In Lecturer D Language D Cycle W Content Th in in m
Workload in Hours In Lecturer Dr Language Dr Cycle W Content Th in in m M
Lecturer D Language D Cycle W Content Th in in m
Language D Cycle W Content Th in m
Cycle W Content Th in m
Content Tř in m
Literature

Module M0639: Gas a	nd Steam Po	wer Plants			
Courses					
Title			Тур	Hrs/wk	СР
Gas and Steam Power Plants (L020	6)		Lecture	3	5
Gas and Steam Power Plants (L021	0)		Recitation Section (large)	1	1
Module Responsible	Dr. Kristin Abel-Gi	inther			
Admission Requirements	None				
Recommended Previous					
Knowledge		Thermodynamics I and II"			
	 "Heat Trans "Fluid Mech 				
		anics			
Educational Objectives	After taking part s	uccessfully, students have	reached the following learning results		
Professional Competence					
Knowledge	The students can	evaluate the development	of the electricity demand and the energy co	onversion routes i	n the thermal pow
	plant, describe the	e various types of power pl	ant and the layout of the steam generator bloc	ck. They are also a	able to determine t
	-		nt. Additionally they can describe the exha		
	-		sil-fuelled power plants with solar thermal a	nd geothermal po	ower plants or plan
	equipped with Car	bon Capture and Storage.			
	The students have	basic knowledge about the	e principles, operation and design of turbomacl	hinery	
Chille	The students will	he chie weine theories of	ad mathada of the anarmy technology from f	inecil fuele and he	and an wall found
SKIIIS		-	nd methods of the energy technology from f of gas and steam power plants, to identify basi		
	-		solutions. Through analysis of the problem a		
	-		dents are endowed with the capability and me		
			the production of heat. From the technical ba		
		-	ity mix composition within the energy-politica		-
	environmental pro				
					-
			dents learn the use of the specialised software		
	tool small practica	I tasks are solved with the	PC, to highlight aspects of the design and deve	lopment of power	plant cycles.
	The students are	able to do simplified calcul	ations on turbomachinery either as part of a	plant, as single co	omponent or at sta
	level.				
Personal Competence					
	An excursion with	n the framework of the lect	ure is planned for students that are interested	The students get	in this manner dire
Social Competence			egion. The students will obtain first-hand expe	-	
			echnical and political issues.	inchee with a pow	
Autonomy			le to develop alone simple simulation models a	and run with these	scenario analyses.
			nowledge from the lecture is consolidated a		-
	process combinat	ions and boundary condit	ions highlighted. The students are able inde	ependently to ana	alyse the operation
	performance of st	eam power plants and calcu	late selected quantities and characteristic cur	ves.	
Workload in Hours	Indonondont Stud	y Time 124, Study Time in I	acturo 56		
Credit points	6	y fille 124, Study fille iff			
Course achievement	Compulsory Bonus	Form	Description		
course achievement	No 5%	Presentation	15-minütiges, unbenotetes Testat	über EBSILON	Professional; n
			bestanden/nicht bestanden (keine anteil	igen Punkte)	
	No 5 %	Excercises	10 Übungsaufgaben im Laufe der Vorles	ungen à 5 Minuter	n; bis zu 5 % Bonus
			nach Anteil richtiger Abgaben		
	No 5 %	Group discussion	gemeinsame Erarbeitung von Inhalten		
	No 5 %	Written elaboration	Zusammenfassung von Literatur		
Examination	Written exam				
Examination duration and	Written examinati	on of 120 min			
scale					
Assignment for the	General Engineeri	ng Science (German progra	m, 7 semester): Specialisation Green Technolo	gies, Focus Renev	vable Energy: Elect
Following Curricula					
			Qualification: Elective Compulsory		
	Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Systems: Elective Compulsory				
	_		Specialisation Energy Technology: Elective Con	mpulsory	
	Mechanical Engine	eering: Specialisation Energ	y Systems: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture	2	2
Thermal Separation Processes (L03		Recitation Section (small)	2 1	2
Fhermal Separation Processes (L0 Separation Processes (L1159)	141)	Recitation Section (large) Practical Course	1	1 1
	Dref Iring Creimans		1	1
Module Responsible				
Admission Requirements				
Recommended Previous		nics III		
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence		reached the following learning results		
Knowledge				
-	adsorptionThe students develop an understandi energy demand of a process, the poss	escribe different types of separation processes ng for the course of concentration during a sep sibilities of energy saving, and the selection of se ng methods for separation processes and device	paration process, t eparation systems	the estimation of
Skills	 Using the gained knowledge the stud close the associated energy and mate The students can use different grap theoretical stages required They can select and design a basic disadvantages of the process The students are capable to obtain in tables) They can calculate continuous and dis The students are able to prove their the colloquium. 	hical methods for the designing of a separation type of thermal separation process for a given adependently the needed material properties fro	on process and d n case based on om appropriate so ork. experimental work s and use it togeth	efine the amour the advantages ources (diagrams with the teache
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 The students can work technical assigned. The students are able to carry out puthem. They are able to discuss their results are capable to obtain the the students are capable to obtain the the students can proof the state of the state	nments in small groups and present the combin ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th i their knowledge with exam resembling assig	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
<i>Social Competence</i> <i>Autonomy</i>	 The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the 	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
<i>Social Competence</i> <i>Autonomy</i>	 The students can work technical assig The students are able to carry out p them. They are able to discuss their re- The students are capable to obtain the The students can proof the state of learning process 	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
Social Competence Autonomy Workload in Hours	 The students can work technical assig The students are able to carry out p them. They are able to discuss their re- The students are capable to obtain the The students can proof the state of learning process 	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement	 The students can work technical assig The students are able to carry out p them. They are able to discuss their re- The students are capable to obtain the The students can proof the state of learning process 	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	 The students can work technical assig The students are able to carry out p them. They are able to discuss their research is the students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calculated	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84	a functional divisi eport. hemselves and as:	ion of labor betw sess their quality
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calculate	ractical lab work in small groups and organize esults and to document them scientifically in a re e needed information from suitable sources by the their knowledge with exam resembling assign ecture 84	a functional divisi eport. hemselves and as: nments and in th	ion of labor betw sess their quality iis way control t
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Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by the their knowledge with exam resembling assigned ecture 84 	a functional divisi eport. hemselves and as: nments and in th	ion of labor betw sess their quality iis way control t
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Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by the their knowledge with exam resembling assigned ecture 84 	a functional divisi eport. hemselves and as nments and in th gies, Focus Renew hnologies, Focus	ion of labor betw sess their quality nis way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (Ge	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by the their knowledge with exam resembling assigned ecture 84 	a functional divisi eport. hemselves and as nments and in th gies, Focus Renew hnologies, Focus neering: Compulso	ion of labor betw sess their quality nis way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Genera	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84 ulations am, 7 semester): Specialisation Green Technolog agram, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Process Engine	a functional divisi eport. hemselves and as: nments and in th gies, Focus Renew hnologies, Focus neering: Compulsor	ion of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Genera	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84 	a functional divisi eport. hemselves and as: nments and in th gies, Focus Renew hnologies, Focus neering: Compulsor	ion of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Genera	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84 ulations am, 7 semester): Specialisation Green Technolog ogram, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Process Engine am, 7 semester): Specialisation Chemical and Bi Compulsory	a functional divisi eport. hemselves and as: nments and in th gies, Focus Renew hnologies, Focus neering: Compulsor	ion of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L G None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Gen	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84 ulations am, 7 semester): Specialisation Green Technolog ogram, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Process Engine am, 7 semester): Specialisation Chemical and Bi Compulsory Qualification: Compulsory	a functional divisi eport. hemselves and as: nments and in th gies, Focus Renew hnologies, Focus neering: Compulsor	ion of labor betw sess their quality is way control t able Energy: Elec Renewable Ene
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Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	The students can work technical assig The students are able to carry out p them. They are able to discuss their re The students are capable to obtain the The students can proof the state of learning process Independent Study Time 96, Study Time in L G None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr. Compulsory General Engineering Science (German progr. Ge	ractical lab work in small groups and organize esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assig ecture 84 ulations am, 7 semester): Specialisation Green Technolog ogram, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Green Tech am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Process Engine am, 7 semester): Specialisation Chemical and Bi Compulsory Qualification: Compulsory	a functional divisi eport. hemselves and as nments and in th gies, Focus Renew hnologies, Focus neering: Compulsor ring: Compulsory oengineering: Con	ion of labor betw sess their quality is way control t able Energy: Elec Renewable Ene

ourse L0119: Thermal Sepa	ration Processes
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 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

ourse L0141: Thermal Sepa				
Тур	ecitation Section (large)			
Hrs/wk				
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Irina Smirnova			
Language	DE			
Cycle	WiSe			
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 			
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 198 Ullmann"s Enzyklopädie der Technischen Chemie 			

ourse L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiun 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 calincrease their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes
Literature	 Selection of separation processes G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to 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

Courses						
Title		Тур	Hrs/wk	СР		
System Integration Renewable Ene		Lecture	2	2		
System Integration Renewable Ene		Recitation Section (small)	1	1		
System Integration Renewable Energies II (L2769)		Lecture Recitation Section (small)	2 1	2		
System Integration Renewable Ene		Recitation Section (Smail)	1	I		
Admission Requirements	Prof. Martin Kaltschmitt					
	Fundamentals of renewable energies and th	o oporau curtom				
Knowledge	Fundamentals of renewable energies and th	e energy system				
	After taking part successfully, students have	reached the following learning results				
Professional Competence	Arter taking part successivity, students nave	reaction and to to to the to to to the to to to the to				
	With the completion of the module the students are able to use and apply the previously learned technical basics of the differ- fields of renewable energies. Current problems concerning the integration of renewable energies in the energy system presented and analyzed. In particular, the sectors electricity, heat and mobility will be addressed, giving students insights i sector coupling activities.					
Skills	s By completing this module, students can apply the basics learned to various sector coupling problems and, in this context, asse the potentials as well as the limits of sector coupling in the German energy system. In particular, the students should use t application and linking of already learned methods and knowledge here, so that a vision of the different technologies is achieved					
Personal Competence						
Social Competence	The students will be able to discuss problems in the areas of sector coupling and the integration of renewable energies.					
Autonomy	r The students are able to acquire own sources based on the main topics of the lecture and to increase their knowledg Furthermore, the students can search further technologies and interconnection possibilities for the energy system itself.					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	General Engineering Science (German progr	am, 7 semester): Specialisation Green Technolog	ies, Focus Renew	able Energy: Elect		
Following Curricula	Compulsory					
	Green Technologies: Energy, Water, Climate	. Consideration Energy Cystome, Elective Commu				

Hrs/wk CP	2					
СР						
	Z Independent Study Time 32, Study Time in Lecture 28					
	Volker Lenz					
Language						
Cycle	WiSe					
Content	1. Introduction					
	2. Fossil-dominated energy system					
	3. Mega trends in energy transition					
	 Characteristics of renewable energy provision technologies - electricity 					
	5. Integration of renewables - electricity I					
	6. Integration of renewables - electricity II					
	7. Characteristics of renewable energy provision technologies - heat					
	8. Integration of renewables - heat I					
	9. Integration of renewables - heat II					
	10. Characteristics of renewable energy provision technologies - mobility					
	11. Integration of renewables - mobility					
	12. Communications technology and control engineering					
	13. Reduction in consumption					
	14. Load management					
	15. Interaction of renewable generation and controlled reduction in demand					
Literature	 D. Thrän (editor): Smart Bioenergy. Technologies and concepts for a more flexible bioenergy provision in future energy systems. Springer, Cham, Heielberg, New York, Dordrecht, London, 2015 					
	 R. von Miller (Hrsg.): Lexikon der Energietechnik und Kraftmaschinen Band 6 und 7. Deutsche Verlags-Anstalt Stuttgart 1965 					
	K. Naumann et. al.: Monitoring Biokraftstoffsektor. 3. Auflage, DBFZ Report Nr. 1, Leipzig, 2016					
	M. Kaltschmitt, W. Streicher, A. Wiese (Hrsg.): Erneuerbare Energien. Systemtechnik, Wirtschaftlichkeit, Umweltaspekte. 4. Auflage, Springer					

Course L2768: System Integr	Course L2768: System Integration Renewable Energies I					
Тур	Recitation Section (small)					
Hrs/wk	1					
CP	1					
Workload in Hours	lent Study Time 16, Study Time in Lecture 14					
Lecturer	ker Lenz					
Language						
Cycle						
Content	See interlocking course					
Literature	See interlocking course					

Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Volker Lenz
Language	DE
Cycle	SoSe
Content	 Introduction Power-to-Hydrogen Power-to-Gas Power-to-Liquid Power-to-Heat Hybrid Technologies Combined Technology Concepts I Combined Technology Concepts II Link-up with renewable industrial production Utilization of residual materials from renewable energy provision Biomass as system stabilizer I Biomass as system stabilizer II System modelling - fundamentals System modelling - approaches and results Planning tools
Literature	 D. Thrän (editor): Smart Bioenergy. Technologies and concepts for a more flexible bioenergy provision in future energy systems. Springer, Cham, Heielberg, New York, Dordrecht, London, 2015 R. von Miller (Hrsg.): Lexikon der Energietechnik und Kraftmaschinen Band 6 und 7. Deutsche Verlags-Anstalt Stuttgar 1965 K. Naumann et. al.: Monitoring Biokraftstoffsektor. 3. Auflage, DBFZ Report Nr. 1, Leipzig, 2016 M. Kaltschmitt, W. Streicher, A. Wiese (Hrsg.): Erneuerbare Energien. Systemtechnik, Wirtschaftlichkeit, Umweltaspekte. 4 Auflage, Springer Berlin Heidelberg, 2006 Bundesministerium für Wirtschaft und Energie: Die Energie der Zukunft.

Course L2770: System Integr	ration Renewable Energies II
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Volker Lenz
Language	DE
Cycle	SoSe
Content	
	1. Introduction 2. Power-to-Hydrogen
	3. Power-to-Gas
	4. Power-to-Liquid
	5. Power-to-Heat
	6. Hybrid Technologies
	7. Combined Technology Concepts I
	8. Combined Technology Concepts II
	9. Link-up with renewable industrial production
	10. Utilization of residual materials from renewable energy provision
	11. Biomass as system stabilizer I
	12. Biomass as system stabilizer II
	13. System modelling - fundamentals
	14. System modelling - approaches and results
	15. Planning tools
Literature	
	• D. Thrän (editor): Smart Bioenergy. Technologies and concepts for a more flexible bioenergy provision in future energy
	systems. Springer,Cham, Heielberg, New York, Dordrecht, London, 2015
	R. von Miller (Hrsg.): Lexikon der Energietechnik und Kraftmaschinen Band 6 und 7. Deutsche Verlags-Anstalt Stuttgar
	1965
	K. Naumann et. al.: Monitoring Biokraftstoffsektor. 3. Auflage, DBFZ Report Nr. 1, Leipzig, 2016
	M. Kaltschmitt, W. Streicher, A. Wiese (Hrsg.): Erneuerbare Energien. Systemtechnik, Wirtschaftlichkeit, Umweltaspekte. 4.
	Auflage, Springer Berlin Heidelberg, 2006
	Bundesministerium für Wirtschaft und Energie: Die Energie der Zukunft.
	1

Module M1235: Electi	ical Power Systems I: Introduction	to Electrical Power Systems					
Courses							
Title		Тур	Hrs/wk	СР			
-	ction to Electrical Power Systems (L1670)	Lecture	3	4			
	tion to Electrical Power Systems (L1671)	Recitation Section (small)	2	2			
Module Responsible	Prof. Christian Becker						
Admission Requirements	None						
	Fundamentals of Electrical Engineering						
Knowledge							
Educational Objectives	After taking part successfully, students have reach	ed the following learning results					
Professional Competence							
Knowledge	Students are able to give an overview of conventional and modern electric power systems. They can explain in detail and criticall evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment int electric power systems.						
Skills	With completion of this module the students are able to apply the acquired skills in applications of the design, integratio development of electric power systems and to assess the results.						
Personal Competence							
Social Competence	The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results front of others.						
Autonomy	Students can independently tap knowledge of the	emphasis of the lectures.					
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70					
Credit points	6						
Course achievement	None						
Examination	Written exam						
Examination duration and	90 - 150 minutes						
scale							
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Enginee	ering: Elective Co	mpulsory			
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Green Technologi	ies, Focus Renew	able Energy: Electiv			
	Compulsory						
	Data Science: Core Qualification: Elective Compulsory						
	Electrical Engineering: Core Qualification: Elective Compulsory						
	Energy Systems: Specialisation Energy Systems: Elective Compulsory						
	Engineering Science: Specialisation Electrical Engin	neering: Elective Compulsory					
	Green Technologies: Energy, Water, Climate: Specialisation Energy Systems: Elective Compulsory						
	Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory						
	Integrated Building Technology: Core Qualification:	Compulsory					
	Renewable Energies: Core Qualification: Compulso						
	Theoretical Mechanical Engineering: Specialisation	Energy Systems: Elective Compulsory					

Тур	Lecture					
Hrs/wk	3					
CP	4					
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42					
Lecturer	Prof. Christian Becker					
Language						
Cycle	WiSe					
Content						
	fundamentals and current development trends in electric power engineering					
	tasks and history of electric power systems					
	symmetric three-phase systems					
	 fundamentals and modelling of eletric power systems 					
	• lines					
	 transformers 					
	synchronous machines					
	 induction machines 					
	 loads and compensation 					
	 grid structures and substations 					
	fundamentals of energy conversion					
	 electro-mechanical energy conversion thermodynamics 					
	 power station technology 					
	 renewable energy conversion systems 					
	steady-state network calculation					
	network modelling					
	 load flow calculation 					
	 (n-1)-criterion 					
	symmetric failure calculations, short-circuit power					
	control in networks and power stations					
	grid protection					
	grid planning					
	power economy fundamentals					
	• power economy rundamentals					
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013					
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017					
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008					

Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	 fundamentals and current development trends in electric power engineering
	tasks and history of electric power systems
	symmetric three-phase systems
	 fundamentals and modelling of eletric power systems
	• lines
	transformers
	synchronous machines
	 induction machines
	 loads and compensation
	 grid structures and substations
	 fundamentals of energy conversion
	 electro-mechanical energy conversion
	 thermodynamics
	 power station technology
	 renewable energy conversion systems
	steady-state network calculation
	entropy state network calculation o network modelling
	load flow calculation
	 (n-1)-criterion
	symmetric failure calculations, short-circuit power
	control in networks and power stations
	grid protection
	grid planning
	power economy fundamentals
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Module M1693: Comp	uter Sci	ence f	or Engineers	- Programming	Concepts, Data Ha	ndling & Com	munication
Courses							
Гitle					Тур	Hrs/wk	СР
Computer Science for Engineers - P	rogramming	Concepts,	Data Handling & Cor	mmunication (L2689)	Lecture	3	3
Computer Science for Engineers - P	Programming	Concepts,	Data Handling & Cor	mmunication (L2690)	Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle	e Fröschle	2				
Admission Requirements	None						
Recommended Previous							
Knowledge							
Educational Objectives	After taking	g part suc	cessfully, students	have reached the follo	wing learning results		
Professional Competence							
Knowledge							
Skills							
Personal Competence							
Social Competence							
Autonomy							
Workload in Hours	Independer	nt Study T	Time 110, Study Tir	me in Lecture 70			
Credit points	6						
Course achievement	Compulsory		Form	Description			
		10 %	Attestation	Testate fin	den semesterbegleitend stat	t.	
Examination	Written exa	am					
Examination duration and	120 min						
scale			a :	-			
Assignment for the Following Curricula			g Science (Germa	n program, 7 semes	ter): Specialisation Mechan	ical Engineering, F	ocus Biomechanio
Following curricula	Compulsor		Science (Corman	aroaram 7 comostor):	Specialisation Biomedical Eng	ainooring: Compuls	251
					Specialisation Green Technol		
	Compulsor		Science (German)	orogram, 7 semester).	opecialisation oreen reenitor	ogies, i ocus iteriew	able Energy. Elect
			n Science (Germar	n program 7 semeste	r): Specialisation Mechanica	al Engineering Foc	us Energy System
	Compulsor		, (.,		
		ngineering		n program, 7 semeste	er): Specialisation Mechanica	al Engineering, Foo	us Aircraft Syster
				n program. 7 semes	ter): Specialisation Mechan	ical Engineering	Focus Mechatroni
	Compulsor			,		J	
			Science (German	program, 7 semester):	Specialisation Mechanical E	ngineering, Focus F	Product Developme
			tive Compulsory			5 5.	
	General En	gineering	Science (German	program, 7 semester):	Specialisation Electrical Engi	neering: Elective Co	mpulsory
					Specialisation Mechanical En		
	Engineering	g: Elective	e Compulsory				
			ing: Core Qualificat	ion: Compulsory			
	Chemical a	nd Biopro	cess Engineering:	Core Qualification: Com	npulsory		
	Electrical E	ngineerin	g: Core Qualificatio	n: Compulsory			
	Green Tech	nologies:	Energy, Water, Cli	mate: Specialisation Er	nergy Systems: Elective Com	pulsory	
	Logistics ar	nd Mobility	y: Specialisation In	formation Technology:	Compulsory		
	Mechatroni	cs: Core (Qualification: Comp	ulsory			
	Process En	gineering	: Core Qualification	: Compulsory			
	Engineering						

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

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

Courses						
Гitle		Тур	Hrs/wk	СР		
Metereology of climate change (L2	749)	Lecture	2	2		
Fechnical measures to mitigate clir	nate change (L2747)	Lecture	2	2		
Fechnical measures to mitigate clir	nate change (L2748)	Recitation Section (small)	2	2		
Module Responsible	Prof. Martin Kaltschmitt					
Admission Requirements	None					
Recommended Previous	none					
Knowledge						
Educational Objectives	After taking part successfully, students h	nave reached the following learning results				
Professional Competence						
	of metereological climate change and technical climate protection in an interdisciplinary manner. Current problems are presen and analyzed in relation to solutions for the mitigation of climate change and the impact of human behavior on the climate described and discussed.					
Skills	Upon completion of this module, students will be able to apply the fundamentals they have learned to various cross-sector problems and, in this context, assess and evaluate the potentials but also the limitations of technical solutions for reducing greenhouse gas emissions and their impact on climate change. In particular, the application and linking of already learn methods and knowledge should be applied by the students here, so that a broad view of the different technologies is gained.					
Personal Competence						
Social Competence	Students will be able to discuss problems in the topic areas of reducing impacts and changing the climate with each other.					
Autonomy	Students will be able to independently access sources and acquire knowledge based on the lecture focus on the subject are Furthermore, students will be able to research further climate change mitigation technologies and climate conditions on their ow					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	General Engineering Science (German pr	rogram, 7 semester): Specialisation Green Techno	logies, Focus Renew	able Energy: Ele		
Following Curricula	Compulsory					

ourse L2749: Metereology o	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dr. Jana Sillmann
Language	DE
Cycle	SoSe
Content	Course Content:
	This course provides a comprehensive introduction to the fundamentals of human-induced climate change. Important concepts such as the Earth's radiation budget, the greenhouse effect, and the various Earth system components (e.g., atmosphere, hydrosphere, cryosphere, biosphere) related to climate change are explained. Fundamentals of climate modeling and climate scenarios are explained. Findings from the Intergovernmental Panel on Climate Change's Assessment Reports are provided in relation to observed and model-based physical climate changes and their impacts on various Earth system components. Furthermore, the impacts of global and regional climate change on society (e.g. agriculture, infrastructure, energy) will be highlighted and especially the changes and impacts of weather and climate extremes will be discussed. In the last part of the lecture, current global and national climate change targets will be explained and discussed in the context of possible scenarios, options and challenges to reduce global warming. Concepts such as "net-zero" emissions and negative emissions will be addressed with important implications for the development of new technologies. Learning Objective: Basic knowledge of human-induced climate change, and how to model climate change, and its impacts on different sectors of the environment and society, and the options and consequences for different sectors to achieve the targeted climate goals (reduction of global warming).
	Structure:
	Introduction Climate Change/Climate Change Reports.
	The climate system
	Observed climate change
	Climate variability
	Climate models
	[200]

Literature	Vorlesungsunterlagen
	Climate quiz and discussion
	Sustainability and climate change
	Climate Engineering
	Scenarios, options and challenges to reduce global warming
	Climate risk and adaptation
	Weather and climate extremes
	Impacts of climate change on different regions and sectors
	Physical climate changes under different scenarios
	Climate scenarios
	Climate models
	Climate variability
	Observed climate change
	The climate system
	Introduction Climate Change/Climate Change Reports.
	Structure:
	Basic knowledge of human-induced climate change, and how to model climate change, and its impacts on different sectors of the environment and society, and the options and consequences for different sectors to achieve the targeted climate goals (reduction of global warming).
	Learning Objective:
	This course provides a comprehensive introduction to the fundamentals of human-induced climate change. Important concept such as the Earth's radiation budget, the greenhouse effect, and the various Earth system components (e.g., atmosphere hydrosphere, cryosphere, biosphere) related to climate change are explained. Fundamentals of climate modeling and climate scenarios are explained. Findings from the Intergovernmental Panel on Climate Change's Assessment Reports are provided in relation to observed and model-based physical climate change on society (e.g. agriculture, infrastructure, energy) will be highlighted and especially the changes and impacts of weather and climate extremes will be discussed. In the last part of the lecture, current global and national climate change targets will be explained and discussed in the context of possible scenarios options and challenges to reduce global warming. Concepts such as "net-zero" emissions and negative emissions will be addresser with important implications for the development of new technologies.
	Course Content:
	Climate quiz and discussion
	Sustainability and climate change
	Climate Engineering
	Scenarios, options and challenges to reduce global warming
	Climate risk and adaptation
	Weather and climate extremes
	Impacts of climate change on different regions and sectors
	Physical climate changes under different scenarios

	asures to mitigate climate change
Тур Hrs/wk	Lecture
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Martin Kaltschmitt, Dr. Ben Norden, Dr. Cornelia Schmidt-Hattenberger
Language	DE
Cycle	SoSe
Content	Lecturers: MK, Dr. Ben Norden (GFZ), Dr. Conny Schmidt-Hattenberger (GFZ)
	Lecture Content:
	The goal of this lecture is to address and present technical measures to mitigate climate change. This primarily includes th immediate means by which climate gas emissions can be reduced when they have already occurred. Specifically, the lectur includes the following content:
	- Overview of the main greenhouse gases emitted, including their global warming potential and the average lifetime of th molecules in the atmosphere.
	- Avoidance Methane (CH ₄) (point sources).
	o Emission sources: Methane slip, methane emission from combustion, etc.
	o Reduction methane slip (including gas extraction, biogas plants, waste management).
	o Reduction of methane from combustion (e.g. power plants, ship engines, car engines, CHP engines, etc.)
	o Reduction of other sources if necessary
	- Avoidance Nitrous oxide (N_2O) (point sources).
	o Emission sources: Combustion processes, production processes, biological nitrogen oxidation, etc.
	o Reduction of combustion processes
	o Reduction of production processes
	o Reduction of biological nitrogen oxidation
	o Reduction of further sources, if necessary
	- Avoidance of other greenhouse gases (including F-gases) (point sources)
	- Avoidance of carbon dioxide from fossil carbon (point sources)
	o Emission sources: Combustion processes, production processes
	o Capture technologies from exhaust gases
	- Capture carbon dioxide from diffuse sources (ambient air)
	- Temporary storage and transport of carbon dioxide
	- Final storage of carbon dioxide
	o Geological framework and storage options, infrastructure (assessment)
	o Surface installations / modes of operation / conditioning of CO $_{ m 2}$ (phase behavior) etc.
	o Thermodynamic framework and interactions
	o Tightness of the storage complex (geomechanics) and long-term behavior (modeling), saltwater displacement and upwelling?
	o Monitoring concepts (monitoring methods from geophysics, geochemistry, microbiology, applied on different spatial an temporal scales) and assessment of storage safety
	o Modeling (static, dynamic, chemical, scale-dependent - borehole, reservoir, energy system modeling).
	o Retrievability (interim storage) and after-use concepts (synthetic fuels)?, backfilling (cements, etc.).
	o Examples
Literature	Vorlesungsunterlagen

Тур	Recitation Section (small)
Hrs/wk	2
СР	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer Language	Prof. Martin Kaltschmitt, Dr. Ben Norden, Dr. Cornelia Schmidt-Hattenberger DE
Cycle	
Content	- Overview of the main greenhouse gases emitted, including their global warming potential and the average lifetime of molecules in the atmosphere.
	- Avoidance Methane (CH4) (point sources).
	o Emission sources: Methane slip, methane emission from combustion, etc.
	o Reduction methane slip (including gas extraction, biogas plants, waste management).
	o Reduction of methane from combustion (e.g. power plants, ship engines, car engines, CHP engines, etc.)
	o Reduction of other sources if necessary
	- Avoidance Nitrous oxide (N2O) (point sources).
	o Emission sources: Combustion processes, production processes, biological nitrogen oxidation, etc.
	o Reduction of combustion processes
	o Reduction of production processes
	o Reduction of biological nitrogen oxidation
	o Reduction of further sources, if necessary
	- Avoidance of other greenhouse gases (including F-gases) (point sources)
	- Avoidance of carbon dioxide from fossil carbon (point sources)
	o Emission sources: Combustion processes, production processes
	o Capture technologies from exhaust gases
	- Capture carbon dioxide from diffuse sources (ambient air)
	- Temporary storage and transport of carbon dioxide
	- Final storage of carbon dioxide
	o Geological framework and storage options, infrastructure (assessment)
	o Surface installations / modes of operation / conditioning of CO2 (phase behavior) etc.
	o Thermodynamic framework and interactions
	o Tightness of the storage complex (geomechanics) and long-term behavior (modeling), saltwater displacement and upwelling?
	o Monitoring concepts (monitoring methods from geophysics, geochemistry, microbiology, applied on different spatial temporal scales) and assessment of storage safety
	o Modeling (static, dynamic, chemical, scale-dependent - borehole, reservoir, energy system modeling).
	o Retrievability (interim storage) and after-use concepts (synthetic fuels)?, backfilling (cements, etc.).
	o Examples
Literature	Vorlesungsunterlagen

Courses							
Title		Тур	Hrs/wk	СР			
Phase Equilibria Thermodynamics (Lecture	2	2			
Phase Equilibria Thermodynamics (Recitation Section (small)	1	2			
Phase Equilibria Thermodynamics (Recitation Section (large)	1	2			
Module Responsible							
Admission Requirements	None Mathematics, Physical Chemistry, Thermodynam	icc Land II					
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermodynam						
Kilowiedge							
Educational Objectives	After taking part successfully, students have read	ched the following learning results					
Professional Competence	Arter taking part successiony, students have read	the following learning results					
Knowledge							
Kilowieuge	 Starting from the very basics of thermod 	lynamics, the students learn the mathemat	ical tools to desc	cribe thermodyna			
	equilibria.						
	 They learn how state variables are influe 	nced by the mixing of compounds and lear	n concepts to qu	antitatively descr			
	these properties.						
	 Moreover, the students learn how phase 	equilibria can be described mathematically	and which pher	iomena may occu			
	different phases (vapor, liquid, solid) coexi	ist in equilibrium. Furthermore the fundamer	ntals of reaction e	quilibria are taugl			
	 For different phase equilibria, several ex 	amples relevant for different kinds of proc	esses are shown	n and the necess			
	knowledge for plotting and interpreting the	e equilibria are taught.					
Skills							
	Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibriu						
	state and know how to simplify these equations meaningfully.						
	The students know models which can be used to determine the properties of the system in the equilibrium state and the man ship to exhibit a second time mathematical value in the second state.						
	are able to solve the resulting mathematical relations.						
	 For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well a model parameters in literature sources. 						
	 Beside pure compound properties the students are capable of describing the properties of mixtures. 						
		nts know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena.					
	Based on their knowledge, the students		ncepts that are	the basis for ma			
	separation and reaction processes in chem	nical engineering.					
Personal Competence							
•	The students are able to work in small groups, t	to solve the corresponding problems and to	present them or	aly to the tutors			
Social competence	other students	to solve the corresponding problems and to	present them of	any to the tators t			
Autonomy							
Autonomy	 The students are able to find necessary inf 	formation self-reliantly in literature sources a	and to judge their	quality.			
	 During the semester the students are a 	able to check their learning progress cont	inuously in exer	cises. Based on t			
	knowledge the students can adept their le	arning process.					
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56					
Credit points							
Course achievement	None						
Examination	Written exam						
Examination duration and	120 minutes; theoretical questions and calculation	ons					
scale							
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Green Technolog	ies, Focus Renew	able Energy: Elec			
Following Curricula							
-	General Engineering Science (German program,	7 semester): Specialisation Chemical and Bio	engineering: Cor	npulsory			
	Bioprocess Engineering: Core Qualification: Comp		-	-			
	Chemical and Bioprocess Engineering: Core Qual	-					
	Green Technologies: Energy, Water, Climate: Spe		Compulsory				
	Green Technologies: Energy, Water, Climate: Spe						
		Sory					

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

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

Focus Water and Environmental Engineering

Module M1627: Water	r and Env	/ironm	ent				
Courses							
					_		
Title	((()) ())				Тур	Hrs/wk	CP
Project on Water, Environment, Tra Water in the Environment (L2461)	ffic (L2462)				Project-/problem-based Learning Lecture	2	3
	Duraf Mathia	- Europh			Lecture	Z	3
Module Responsible Admission Requirements		S EINSL					
•							
Recommended Previous Knowledge	Basic knowle	eage of ci	hemistry				
Educational Objectives	After taking	part succ	essfully, students hav	e reached the followi	ng learning results		
Professional Competence	Churchen en				an inconcentral and die Theorem at		
Knowledge			·		environmental media. The can d		5
	natural as well as anthropogenic materials. They are capable of explaining the natural condition of waters and other environmental media.						
Skille				nt specific aspects o	f civil engineering independent	Thoy can n	rocont their findings
38///3					hort summary including scientifi		nesenc their midnigs
	using accree		ternie media (e.g. pos	ters) and can give a s	nore summary mendaning sciencin	le references.	
Personal Competence							
Social Competence	Students can fulfil a complex environment-related assignment in the field of civil engineering by working in a team.						
Autonomy							
Workload in Hours	Independent	t Study Ti	me 124 Study Time i	n Lecture 56			
Credit points		c Study II	ine 124, study fille f				
Course achievement	Compulsory	Bonus	Form	Description			
course achievement	Yes I	None	Presentation	Team-Projekt	tarbeit mit Präsentation		
Examination	Written exa	m					
Examination duration and	60 min						
scale							
Assignment for the	General Eng	ineering	Science (German pro	gram, 7 semester): S	pecialisation Green Technologies	s, Focus Wate	r and Environmental
Following Curricula	Engineering: Elective Compulsory						
	Civil- and Er	vironmer	ntal Engineering: Core	Qualification: Compu	lsory		
	Green Techr	nologies:	Energy, Water, Climat	e: Specialisation Wate	er: Elective Compulsory		

Course L2462: Project on Water, Environment, Traffic		
Тур	Project-/problem-based Learning	
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	SoSe	
Content	Lecturers of Civicl Engineering provide duties on environmentally relevant fields of civil engineering for smal student groups (max. 4 students).	
Literature	aufgabenspeziifisch / according to corresponding tasks	

Course L2461: Water in the E	ourse L2461: Water in the Environment		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Mathias Ernst, Dozenten des SD B		
Language	DE		
Cycle	SoSe		
Content	 Basics of global/regional Water Cycle quality of water natural/anthropogenic water ingredients Basics water science water legislation (EU/D) 		
Literature	Schwoerbel, J. 2005: Einführung in die Limnologie. Heidelberg: Elsevier Grohmann, A. u. a. 2011: Wasser. Berlin: de Gruyter Kluth, W. & Schmeddinck, U. 2013: Umweltrecht: Ein Lehrbuch. Wiesbaden: Springer		

Courses					
īitle		Тур	Hrs/wk	СР	
ntroduction to Microplastics in Env	vironment (L2755)	Integrated Lecture	2	2	
Research Methods (L2756)		Lecture	1	2	
Research Trends (L2757)		Seminar	2	2	
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
Recommended Previous	Basic knowledge in water and environmental-r	elated research			
Knowledge					
Educational Objectives	After taking part successfully, students have re	eached the following learning results			
Professional Competence					
Knowledge	The students will be introduced to current rese	earch topics relevant to water and environm	ent with a particula	r focus on the effe	
	of microplastics in environment (introductory level). Data analysis, curation and presentation will be other skills discussed in the				
	module.				
Skills	Students' research and academics skills will	be improved in this module. How to pre-	pare and deliver a	n effective resea	
	presentation, how to write an abstract, researc				
Personal Competence					
Social Competence	Developing teamwork and problem solving skil	Is through Research-Based Teaching approa	aches will be at the	core of this module	
Autonomy	The students will be involved in writing individual project reports and giving research presentation. This will contribute to th				
	students' ability and willingness to work indepe				
Workload in Hours		ecture 70			
Credit points					
Course achievement					
Examination					
Examination duration and	•				
scale					
Assignment for the		n, 7 semester): Specialisation Green Techn	ologies, Focus Wate	r and Environmen	
Following Curricula					
	Civil- and Environmental Engineering: Specialis		npulsory		
	Green Technologies: Energy, Water, Climate: S	pecialisation Water: Elective Compulsory			
	to Microplastics in Environment				
Тур	-				
Hrs/wk					
CP					
Workload in Hours		ture 28			
Lecturer	Prof. Nima Shokri				
Language					
Language Cycle	WiSe				
Cycle	WiSe Introduction - course objectives, expectations a	and format;			
Cycle	Introduction - course objectives, expectations a	and format;			
Cycle		and format;			

Тур	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Introduction - course objectives, expectations and format;
	Source of microplastics in environment;
	Microplastics sampling; Characterization of microplastics;
	Fate and distribution of microplastics in terrestrial environments;
	Effects of microplastics on terrestrial environments;
	Health risks of microplastics in environments
Literature	1- Characterization and Analysis of Microplastics, Volume 75 1st Edition
	Series Volume Editors: Teresa Rocha-Santos Armando Duarte
	Elsevier, published in 2017
	2- Microplastic Pollutants 1st Edition
	Authors: Christopher Blair Crawford, Brian Quinn
	Elsevier Science, published in 2016
	3- Microplastics in Terrestrial Environments
	Authors: Defu He and Yongming Luo
	Springer, published in 2020, DOI https://doi.org/10.1007/978-3-030-56271-7

Course L2756: Research Met	hods
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Introduction - course objectives, expectations and format
	Analyzing the Audience, purpose and occasion
	Constructing and delivering effective technical presentations
	How to write an abstract
	How to create a scientific poster
	How to write a scientific paper
	Individual project on water and environmental research
	Presentation on water and environmental research
Literature	The Craft of Scientific Writing Fourth edition
	Author: Michael Alley
	Springer-Verlag New York, Copyright 2018, DOI 10.1007/978-1-4419-8288-9
	Supplemental materials and web links which will be available to registered students.

Course L2757: Research Tren	lds	
Тур	Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Anna Luisa Hemshorn de Sánchez	
Language	EN	
Cycle	WiSe	
Content	Introduction - course objectives, expectations and format	
	Analyzing the Audience, purpose and occasion	
	Constructing and delivering effective technical presentations	
	How to write an abstract	
	How to write a scientific paper	
	Developing competitive and persuasive research proposals	
	Databases and resources available for water and environmental research	
	Individual proposal on water and environmental research	
	ndividual project on water and environmental research	
	Group projects and presentation on water and environmental research	
Literature	The Craft of Scientific Writing Fourth edition	
	Author: Michael Alley	
	Springer-Verlag New York, Copyright 2018, DOI 10.1007/978-1-4419-8288-9	
	Supplemental materials and web links which will be available to registered students.	

2					
Courses					
Title		Тур	Hrs/wk	СР	
Study Work Green Technologies (L2 Scientific Work and Writing (L2765)		Project Seminar Seminar	2	4	
	Dozenten des Studiengangs	Seminar	L	L	
Admission Requirements	None				
Recommended Previous	keine				
Knowledge	Kente				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results			
Professional Competence	51				
-	The students, based on a literature survey	y, learn to study in detail a subject theme fro	m the disciplines of gro	een technologies a	
5		n to a specialised audience. Environmental is			
	preferred, when selecting the thematic are	ea of these studies. Through their own writter	n contribution the stude	ents communicate	
	overview over the subject and practice	technical writing. With the discussion the	students practice scie	entific debating on	
	specialised subject matter.				
Skills	The students can, when working on a tech	nnical tonic not familiar to them.			
SKIIIS	The students call, when working on a tech				
	 conduct a literature survey 				
	 choose the relevant information for 	their presentation			
	 prepare a written summary 				
	 present results in front of peers and 	d staff			
	 correctly cite and reference sources 	5.			
Personal Competence					
Social Competence	The students practice a critical assessme	nt of the literature in a predefined specialise	d theme and learn to c	nive presentations	
boelar competence	The students practice a critical assessment of the literature in a predefined specialised theme and learn to give presentations on their own technical sub-topic tailored to their public and discuss with the audience. When attending technical presentations, the				
		speakers and participate in the ensuing disc	-		
	The fulfilment of the tasks combines indep	pendent work with group and teamwork.			
Autonomy	The students can, guided by instructors, c	ritically reflect on their learning and work sta	tus, and write a scientif	fic report.	
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Study work				
Examination duration and	?				
scale					
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Green Tech	nologies, Focus Renew	able Energy: Elect	
Following Curricula	Compulsory				
	General Engineering Science (German pro	ogram, 7 semester): Specialisation Green Tec	hnologies, Focus Wate	r and Environment	
	Engineering: Elective Compulsory	,			
	Green Technologies: Energy, Water, Clima	ate: Specialisation Energy Technology: Electiv	e Compulsory		
		ate: Specialisation Water: Elective Compulsory			
	Green Technologies: Energy, Water, Clima	ate: Specialisation Energy Systems: Elective C	ompulsory		
		ate: Specialisation Bioresource Technology: El			

Course L2766: Study Work G	reen Technologies
Тур	Project Seminar
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dozenten des Studiengangs
Language	DE
Cycle	WiSe
Content	Students carry out a research project in a scientific field under the guidance of an academic staff member. For this purpose, the student can approach the staff of the respective institute and discuss a topic. The topic is then worked on within 4 weeks and regular consultations are held with the supervisor. The student research project should be the size of a scientific article.
Literature	

Тур	Seminar		
Hrs/wk	2		
CP	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Dozenten des Studiengangs, Dr. Detlev Bieler, Florian Hagen		
Language	DE		
Cycle	WiSe		
Content	The seminar offers an introduction into the diverse aspects of academic research and writing: Finding the topic, finding speci information, knowledge organisation, writing, presenting and publishing. Suggestions for reflecting own processes of lea informing and writing - in addition to practical recommendations and tips - facilitate the start and the creation of bachelo master theses, works, which bring thoroughly self-fulfilment and make fun.		
	Topics of the seminar will be in particular		
	Scientific scholarship and academic research methods:		
	 Introduction, organization, attributes of science: 		
	How is scientific knowledge created?		
	Work scheduling, finding topics, time management, specialities of academic research in engineering		
	• Finding specialized information: Full texts and library resources, databases http://www.tub.tuhh.de/en/su		
	information/informing-points-to-survive/		
	 Reference management: http://www.tub.tuhh.de/en/publishing/reference-management/ 		
	Knowledge organisation and creating publications with Citavi		
	Citing correctly and avoiding plagiarism		
	Preparing and doing presentations		
Literature			
	 Semesterapparat "Wissenschaftliches Arbeiten" in der TU-Bibliothek: http://tinyurl.com/Semesterapparat-Wiss-Arbeiter Weblog Wissenschaftliches Arbeiten der TU-Bibliothek: https://www.tub.tuhh.de/wissenschaftliches-arbeiten/ Online-Tutorial VISION der TU-Bibliothek zum wissenschaftlichen Arbeiten: https://www.vision.tuhh.de (funktioniert nr installiertem Flash) Andreas Hirsch-Weber, Stefan Scherer: Wissenschaftliches Arbeiten und Abschlussarbeit in Natur- Ingenieurwissenschaften : Grundlagen, Praxisbeispiele, Übungen. Stuttgart: Ulmer, 2016. Webrag Serielt, Einführung in des wissenschaftliche Arbeiten ; inklusive E Learning, Web Becharche, digitale Präsen 		
	 Werner Sesink: Einführung in das wissenschaftliche Arbeiten : inklusive E-Learning, Web-Recherche, digitale Präsen u.a. 9., aktualisierte Aufl. München : Oldenbourg, 2012. Judith Theuerkauf: Schreiben im Ingenieurstudium : effektiv und effizient zur Bachelor-, Master- und Doktora 		
	 Paderborn : Schöningh, 2012. Wolfsberger, Judith: Frei geschrieben : Mut, Freiheit & Strategie für wissenschaftliche Abschlussarbeiten. Wien: Böhlau, 		
	 Wonsberger, Journ. Her geschneben - Hat, Henere & Stategre für Wissenschaften – Abseindsarbeiten, Wein Donida Biedermann, Wieland u.a.: Forschungsmethodik in den Ingenieurwissenschaften : Skript vom Lehrstu Produktentwicklung, Prof. DrIng. Udo Lindemann, Technische Universität München (TUM), https://www.mw.tum.de/fileadmin/w00btx/lpl/Documents/Forschungsmethodik_Skript.pdf Wissenschaftliches Arbeiten - HOOU Angebot der HCU Hamburg: https://blogs.hoou.de/wissarbeiten/ 		
	1. Course Reserves Collection "Scholarly Research Methods" in the TUHH library: http://tinyurl.com/Semesterapparat Arbeiten		
	 Scholarly research methods via TUHH library Website: https://www.tub.tuhh.de/en/scholarly-research-methods/ 		
	 VISION - Online-Tutorial on research methods by the TUHH library: http://www.vision.tuhh.de (Flash has to be installed) 		
	 Scientific papers and presentations / Martha Davis. 3. ed. Amsterdam: Elsevier / Academic Press, http://www.sciencedirect.com/science/book/9780123847270 		
	 Writing for science and engineering : papers, presentations and reports / Heather Silyn-Roberts. 2nd ed. Amsterd Elsevier, 2013. http://www.sciencedirect.com/science/book/9780080982854 		
	 How to research / Loraine Blaxter, Christina Hughes and Malcolm Tight. Maidenhead : Open Univ. Press, 2010. Managing information for research : practical help in researching, writing and designing dissertations / Elizabeth Orr Graham Stevens. Maidenhead : Open University Press McGraw-Hill, 2009. 		
	 Writing scientific research articles : strategy and steps / Margaret Cargill and Patrick O'Connor. Chichester : Wiley-Blac 2009. 		

	ulic Engineering					
Courses						
Title			-	Гур	Hrs/wk	СР
Hydraulics (L0957)				_ecture	1	1
Hydraulics (L0958)			F	Project-/problem-based Learning	1	1
- Hydraulic Engineering (L0959)				Lecture	2	2
Hydraulic Engineering (L0960)			F	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle					
Admission Requirements	None					
Recommended Previous	Hydraulic Engineering I					
Knowledge						
Educational Objectives	After taking part successfu	lly, students have re	eached the following	g learning results		
Professional Competence						
Knowledge	Students are able to defin	e the basic terms o	f hydraulic enginee	ering and hydraulics. They are	able to expla	in the application
	basic hydrodynamic formu	lations (conservatio	n laws) to practical	hydraulic engineering proble	ms. Besides th	is, the students o
	illustrate important tasks o	of hydraulic enginee	ring and give an ov	verview over river engineering	, flood protect	ion, hydraulic pov
	engineering and waterways	s engineering.				
<i>CL 11</i>						
Skills				d approaches to basic practic		
				and apply established approx		
			-	, etc.) on channel flows as wel	l as flow condi	tions of pipe syste
	Furthermore, they are able	to run, explain and	document basic hy	draulic experiments.		
Personal Competence						
	The students are able to d	leploy their gained	knowledge in applie	ed problems. Additionaly, they	will be able t	o work in team w
,				nanner. They can explain the		
	approaches.	-			-	
Autonomy	The students will be able to	o independently ext	end their knowledge	e and apply it to new problems	. Furthermore	, they are capable
				of experiments and to present		
Workload in Hours	Independent Study Time 1	10, Study Time in Le	ecture 70			
Credit points	6					
Course achievement	Compulsory Bonus Form	n	Description			
	Yes None Sub	ject theoretical	andDurchführung,	Dokumentation und Prä	sentation zu	einem Versuo
	prae	ctical work	Hydromechani	k oder Hydraulik		
Examination	Written exam					
Examination duration and	The duration of the exam	ination is 2 hours.	The examination ir	cludes tasks with respect to	the general u	nderstanding of
scale	lecture contents and calcul	ations tasks.				
Assignment for the	General Engineering Science	ce (German program	n, 7 semester): Spec	cialisation Civil Engineering: El	ective Compul	sory
Following Curricula	General Engineering Scien	ce (German prograr	n, 7 semester): Spe	ecialisation Green Technologies	s, Focus Water	and Environmen
	Engineering: Elective Comp	oulsory				
	Civil- and Environmental Er	ngineering: Core Qu	alification: Compuls	ory		
	General Engineering Science	ce (English program	, 7 semester): Spec	ialisation Civil Engineering: Ele	ctive Compuls	ory
	Green Technologies: Energ	y, Water, Climate: S	pecialisation Water	: Elective Compulsory		
Course L0957: Hydraulics	Lashuus					
Тур	Lecture					
Hrs/wk	1					
CP	1					
	Independent Study Time 1	5, Study Time in Lec	ture 14			
Workload in Hours						
Lecturer	Prof. Peter Fröhle					
Lecturer Language	DE					
Lecturer	DE WiSe/SoSe					
Lecturer Language	DE	ነs in pipes and oper	a channels			

- Hydraulics of pipesPunps in hydraulic systems
- Open channel flow
- Regulative construction in open channel flow
 - Weirs
 - Sliding panels
 - Cross-section reduction by constructions

Literature	Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-
	Verlag, 2003
	Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

Course L0958: Hydraulics		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe/SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0959: Hydraulic Engi	ineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe/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
	Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011

Course L0960: Hydraulic Eng	urse L0960: Hydraulic Engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe/SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1632: Applie	ed Water Management			
House Higgs applie				
Courses				
Title		Тур	Hrs/wk	СР
Nature-oriented Hydraulic Engineer		Project-/problem-based Learni	5	2
Numerical modelling of soil water d		Project-/problem-based Learni	-	2
Numerical modelling of soil water dy		Lecture	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Basic knowledge of analysis and differ hydromechanical and hydraulic engine 	•		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students are able to define the basic tasks and terms of nature-oriented hydraulic engineering und groundwater hydrology. The cam describe the basics concepts, the basic approaches and methods of nature-oriented hydraulic engineering, groundwater hydrology and groundwater modelling and are able to apply these to practical problems.			
	The students are able to apply the methods and approaches of nature-oriented hydraulic engineering and of groundwater hydrology to practical problems. They can demonstrate to transfer and apply these to simple hydraulic engineering systems. In addition, they are able to apply the approaches commonly used in groundwater hydrology. They can exemplarily explain and reason how to apply them as a basis for geo-hydrological questions. In addition, students can apply basic groundwater modellin methods to simple problems of groundwater movement and groundwater recharge.			
Personal Competence				
	Students are able to help each other solving case studies. The students are able to deploy their gained knowledge in applie problems of the practical nature-based hydraulic engineering. Additionaly, they will be able to demonstrate to work cooperative in teams consisting of engineers from different subject areas.			
Autonomy	The students will be able to independently ex	ttend their knowledge and apply it to new proble	ems.	
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Written-theoretical part and modeling			
scale				
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Green Technolo	gies, Focus Wate	er and Environmenta
Following Curricula	Engineering: Elective Compulsory			
	Civil- and Environmental Engineering: Specia	lisation Civil Engineering: Elective Compulsory		
	Civil- and Environmental Engineering: Specia	lisation Traffic and Mobility: Elective Compulsory	,	
		ibution manie and nobility i Liective comparison		
		lisation Water and Environment: Elective Comp		

Course L2472: Nature-oriented Hydraulic Engineering		
Тур	Project-/problem-based Learning	
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	 Regime-theory and application for the development of environmental guiding priciples of rivers Engineering-biological measures for the stabilization of rivers design techniques for water engineering hydraulic dimensioning of river bed and bank protection design principles and design techniques for fish passages (fish ladder, ramps etc.) 	
Literature		

Course L2471: Numerical modelling of soil water dynamics		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Hannes Nevermann	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2470: Numerical mo	delling of soil water dynamics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	 Hydrologic water bilance aquifertyps groundwater velocities Darcy law groundwater contour lines storage capacity flow equation pumping tests method of Beyer solute transport in groundwater Basics and theoretical background of simulation methods for the analysis of water movement in vadose zone groundwater recharge
Literature	Todd, K. (2005): Groundwater Hydrology Fetter, C. W. (2001): Applied Hydrogeology Hölting, B. & Coldewey, W. (2005): Hydrogeologie Charbeneau, R. J. (2000): Groundwater Hydraulics and pollutant Transport

Module M0670: Partic	le Techn	ology	and Solids Proces	s Engineerii	ng		
Courses							
Title					Тур	Hrs/wk	СР
Particle Technology I (L0434)					Lecture	2	3
Particle Technology I (L0435)					Recitation Section (small)	1	1
Particle Technology I (L0440)					Practical Course	2	2
Module Responsible	Prof. Stefan I	Heinrich					
Admission Requirements	None						
Recommended Previous	keine						
Knowledge							
Educational Objectives	After taking	part succ	essfully, students have re	ached the followin	g learning results		
Professional Competence							
Knowledge	After success	sful comp	letion of the module stude	ents are able to			
		ممط ميرما	in pressess and unit or	anations of colida			
			ain processes and unit-op rticles, particle distributio				
		Lienze pa	rticles, particle distributio		uten buik properties		
Skills	Students are	able to					
	• choose	e and des	ign apparatuses and proc	esses for solids pr	ocessing according to the o	desired solids prop	erties of the produ
	 choose and design apparatuses and processes for solids processing according to the desired solids properties of the product asses solids with respect to their behavior in solids processing steps 						
			work scientifically.		5		
Personal Competence							
Social Competence				pics orally with ot	her students or scientific	personal and to o	develop solutions f
			ues in a group.				
Autonomy	Students are	able to a	nalyze and solve question	ns regarding solid	particles independently.		
Workload in Hours	Independent	Study Tir	me 110, Study Time in Le	cture 70			
Credit points	6						
Course achievement	Compulsory B	onus	Form	Description			
	Yes N	lone	Written elaboration	sechs Berichte	e (pro Versuch ein Bericht)	à 5-10 Seiten	
Examination	Written exan	n					
Examination duration and	90 minutes						
scale							
Assignment for the	General Engi	ineering 9	Science (German program	n, 7 semester): Sp	ecialisation Green Technolo	ogies, Focus Wate	r and Environment
Following Curricula	Engineering:	Elective	Compulsory				
	General Engi	neering S	cience (German program	, 7 semester): Spe	cialisation Bioprocess Engi	neering: Compulso	ory
	General Engi	neering S	cience (German program	, 7 semester): Spe	cialisation Process Enginee	ring: Compulsory	
	General Engi	neering S	cience (German program	, 7 semester): Spe	cialisation Chemical and Bi	oengineering: Cor	npulsory
	Bioprocess E	ngineerin	g: Core Qualification: Con	npulsory			
	Chemical and	d Bioproc	ess Engineering: Core Qua	alification: Compu	sory		
	Energy and E	Environme	ental Engineering: Core Q	ualification: Electiv	e Compulsory		
	Green Techn	ologies: E	nergy, Water, Climate: Sp	pecialisation Wate	r: Elective Compulsory		
	Process Engi	neering:	Core Qualification: Compu	llsorv			

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

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

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

Module M1630: Sanit	ary Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Management of Wastewater Infras	ructure (L2467)	Seminar	2	3
Drinking Water Treatment (L2466)		Seminar	2	3
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Basic knowledge in the field of drinking	water supply and waste water disposal.		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can examplify their expe	rt knowledge on drinking water, waste water tre	atment and the asso	ciated infrastructur
2		ing the relevant empiricals assumptions and scien		
		cally. They can also assess existing problems in		
		socio-political context. Furthermore, they know h	-	
		such as high- and low-pressure membrane filtrati		
	of important technologies of the future	such as high- and low-pressure membrane merad	on systems and teem	iiques.
Skills	The students are able to apply the rele	vant standards and guidelines for the design and	d operation of urban	water infrastructure
	independently. Their expertise comprise	es expert skills to design drinking water supply a	nd urban drainage sy	stems as well as th
	associated treatment facilities. Besides	the acquirement of technical skills the students	are able to address a	nd solve biochemica
	problems in the filed of drinking water	and wastewater treatment. The students are a	lso able to develop i	deas of their own t
	improve the existing water related infra	structures, systems and concepts.		
Personal Competence				
Social Competence	The students are able to develop a spec	ific topic in a team and to work out milestones ac	cording to a given pla	an.
Autonomy	Students are in a position to work on	a subject and to organize their work flow indep	nendently. They can	also present on thi
Autonomy	subject.	a subject and to organize their work now mac	sendentry. They can t	
	Subject.			
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Written-theoretical part and modelling			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Green Tech	nologies, Focus Water	r and Environmenta
-	Engineering: Elective Compulsory	· · · · · · · · · · · · · · · · · · ·		
J		pecialisation Water and Environment: Compulsory	v	
		pecialisation Civil Engineering: Elective Compulso	-	
		pecialisation Traffic and Mobility: Elective Computed	-	
		mate: Specialisation Water: Elective Compulsory		
	Green reenhologies. Energy, Water, Cill	nate. specialisation water. Elective compulsory		

Course L2467: Management	of Wastewater Infrastructure
Тур	Seminar
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	The seminar ""Infrastructure Management Wastewater"" develops the understanding of infrastructure systems in relation to wastewater systems, but also addresses other infrastructure systems.
	Initially, an overview of the entire system is given, including water catchment areas, water distribution, the origin of wastewater in households and industry, stormwater runoff management, and the treatment and reuse of water (constituents). Thereby the design tools especially of digital modelling are understood by practical application. Energetic considerations as well as planning and restoration of pipeline systems are covered.
	For wastewater treatment, the basis developed in Sanitary Engineering I will be deepened and significantly expanded, especially the resource recovery of nutrients and water. Sanitary solutions for different socio-economic and climatic conditions are understood and calculated.
Literature	Gujer, W. (2007): Siedlungswasserwirtschaft, Springer, Berlin Heidelberg
	Metcalf and Eddy (2003): Wastewater Engineering : Treatment and Reuse, Boston, McGraw-Hill
	Henze, M. (1997): Wastewater Treatment : Biological and Chemical Processes, Berlin, Springer
	Stein D., Stein R. (2014): Instandhaltung von Kanalisationen, Verlag Prof. DrIng. Stein & Partner GmbH
	Wossog, G. (2016): Handbuch für den Rohrleitungsbau Band 1 und 2
	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (2009): Abwasserableitung : Bemessungsgrundlagen, Regenwasserbewirtschaftung, Fremdwasser, Netzsanierung, Grundstücksentwässerung, Weimar, UnivVerl.
	DWA Arbeitsblätter

Course L2466: Drinking Wate	er Treatment
Тур	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst, Dr. Klaus Johannsen
Language	DE
Cycle	SoSe
Content	The seminar deepens and expands the knowledge of the processes of drinking water treatment. The seminar deals with ion exchange, oxidation, disinfection, gas exchange and hybrid treatment processes. Further topics include pH adjustment and energy efficiency in water supply. Within the scope of the course, the students work out a seminar performance (presentation, design, modelling) on the basis of a task.
Literature	Worch, E. (2019): Drinking Water Treatment, De Gruyter-Verlag Worch, E. (2015): Hydrochemistry, De Gruyter-Verlag Jekel, M., Czekalla, C. (2016): Wasseraufbereitung - Grundlagen und Verfahren (DVGW Lehr- und Handbuch Wasserversorgung, Band 6), DIV Deutscher Industrieverlag

Specialization Computer Science

The specialization in "Computer Science" allows the graduates to work in the IT sector and to enter Master studies. The Graduates are able to cooperate with Computer Scientists for the design and realization of complex IT tasks. The Graduates should be in the position to adapt to new developments. They should be able to become professionals in almost all branches.

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

Courses						
				True	Line (sub	CD.
F itle Computer Engineering (L0321)				Typ Lecture	Hrs/wk 3	CP 4
Computer Engineering (L0324)				Recitation Section (small)		2
Module Responsible	Prof. Heiko Falk					
	None					
	Basic knowledge in elect	trical engineering				
Knowledge		, , , , , , , , , , , , , , , , , , ,				
Educational Objectives	After taking part succes	sfully, students ha	ve reached the follow	wing learning results		
Professional Competence	51			5 5		
5	programming down to g			of computing systems. It o g topics:	covers the layers fr	rom the assembly-l
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based or collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comput system and the software executed on it. In particular, they shall understand the consequences that the execution of software hon the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalua 					
				and to present the results ature and to associate this		her classes.
Workload in Hours	Independent Study Time	e 124, Study Time	in Lecture 56			
Credit points	6					
Course achievement	Compulsory Bonus F	orm	Description			
	Yes 10 % E	Excercises				
Examination	Written exam					
Examination duration and	90 minutes, contents of	course and labs				
scale						
Assignment for the	General Engineering Sci	ence (German pro	aram. 7 semester): §	Specialisation Computer Sc	cience: Compulsory	
	Compulsory General Engineering So Engineering: Compulsor General Engineering Sci Engineering: Compulsor General Engineering S Engineering Sciences: C	cience (German p y ience (German pro y Gcience (German compulsory	rogram, 7 semeste gram, 7 semester): <u>s</u> program, 7 semes	ter): Specialisation Mechan r): Specialisation Mechan Specialisation Mechanical I ster): Specialisation Mech Specialisation Mechanical	ical Engineering, F Engineering, Focus hanical Engineerin	ocus Aircraft Syst Theoretical Mechar g, Focus Materials
	Seneral Lighteening SC		gram, / semester):	Specialisation Mechanical	Ligineeing, rocu	s nouuce Developin
	and Production: Compul General Engineering So Compulsory General Engineering S Compulsory General Engineering Sci	cience (German p cience (German ence (German pro	program, 7 semest gram, 7 semester): S	r): Specialisation Mechani er): Specialisation Mecha Specialisation Electrical En- specialisation Green Techn	anical Engineering, gineering: Compuls	Focus Biomechar

Electrical Engineering: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0561: Discre	ete Algebraic Structures			
Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures (L0164)		Lecture	2	3
Discrete Algebraic Structures (L016	5)	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	ve reached the following learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic structures including elementary combinatorial structures, monoids, groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific problem	ns alone or in a group and to present the results a	accordingly.	
Autonomy	Students are able to acquire new knowle classes.	edge from specific standard books and to asso	ciate the acquired	knowledge to othe
Workload in Hours	Independent Study Time 124, Study Time i	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German proc	gram, 7 semester): Specialisation Computer Scier	nce: Compulsory	
Following Curricula	Computer Science: Core Qualification: Com	npulsory		
	Data Science: Core Qualification: Compulso	ory		
	Computer Science in Engineering: Core Qu	alification: Compulsory		
	Orientation Studies: Core Qualification: Ele	ctive Compulsory		

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

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

6				
Courses				
Title		Тур	Hrs/wk	СР
Graph Theory and Optimization (L1 Graph Theory and Optimization (L1		Lecture Recitation Section (small)	2	3 3
Module Responsible		Reclation Section (Small)	Z	5
Admission Requirements Recommended Previous	None			
Keconmended Previous	Discrete Algebraic Structures			
Knowneuge	Mathematics I			
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence	······································	······ ·······························		
Knowledge				
		Graph Theory and Optimization. They are	able to explain the	em using appropria
	examples.			
	-	between these concepts. They are capabl	e of illustrating th	ese connections wi
	the help of examples.	- duran dikana		
	They know proof strategies and can repro	duce them.		
Skills	. Chudonka con model problems in Cronh	Theory and Optimization with the help of	the concepte et	diad in this saure
	 Students can model problems in Graph Moreover, they are capable of solving the 	Theory and Optimization with the help of	the concepts stu	idied in this cours
		further logical connections between the conc	opts studied in the	COURSO
		develop and execute a suitable approach,		
	results.			indeally evaluate t
Personal Competence				
Social Competence				
	 Students are able to work together in tea 	ms. They are capable to use mathematics as	a common langu	age.
		concepts according to the needs of their coo	perating partners	. Moreover, they ca
	design examples to check and deepen th	e understanding of their peers.		
Autonomy	Students are capable of checking their u	inderstanding of complex concepts on their	own. They can sp	ecify open questio
	precisely and know where to get help in s			
	Students have developed sufficient pers	istence to be able to work for longer perio	ds in a goal-orien	ted manner on ha
	problems.			
	Independent Study Time 124, Study Time in Leo	ture 56		
Credit points				
Course achievement Examination				
Examination Examination duration and				
scale				
Sture				
Assignment for the	General Engineering Science (German program,		ce: Compulsory	
Following Curricula	Computer Science: Core Qualification: Compulse	ory		
	Data Science: Core Qualification: Compulsory			
	Logistics and Mobility: Specialisation Engineerin			
	Logistics and Mobility: Specialisation Traffic Plar			
	Logistics and Mobility: Specialisation Information			
	Technomathematics: Specialisation I. Mathemat			
	Engineering and Management - Major in Logistic	s and Mobility: Specialisation Traffic Plannin	g and Systems: Ele	ective Compulsory

Course L1046: Graph Theory	and Optimization
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
Cycle	SoSe
Content	 Graphs, search algorithms for graphs, trees planar graphs shortest paths minimum spanning trees maximum flow and minimum cut theorems of Menger, König-Egervary, Hall NP-complete problems backtracking and heuristics linear programming duality integer linear programming
Literature	 M. Aigner: Diskrete Mathematik, Vieweg, 2004 T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Algorithmen - Eine Einführung, Oldenbourg, 2013 J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007 A. Steger: Diskrete Strukturen (Band 1), Springer, 2001 A. Taraz: Diskrete Mathematik, Birkhäuser, 2012 V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009 KH. Zimmermann: Diskrete Mathematik, BoD, 2006

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

Courses				
Title		Turn	Hre /w/r	СР
Stochastics (L0777)		Typ Lecture	Hrs/wk 2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Matthias Schulte			
Admission Requirements	None			
Recommended Previous				
Knowledge	Calculus			
	Discrete algebraic structures (combinatorics)			
	Propositional logic			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
	 Students can name the basic concepts in Stoc 			
	 Students can discuss logical connections betw 	veen these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and can reproduce 	them.		
Skills				
	Students can model problems from stochasti		d in this course	. Moreover, they a
	capable of solving them by applying establishe			
	Students are able to discover and verify further	-		
	 For a given problem, the students can devel results. 	op and execute a suitable approach, a	nd are able to c	ritically evaluate t
	Tesuits.			
Personal Competence				
Social Competence	Churchenster and a blacker words to worth an (a. e. an bl			
	 Students are able to work together (e.g. on the different study programs and background know 			
	different study programs and background knoIn doing so, they can communicate new conce			
	design examples to check and deepen the und		ferating partners	. Moreover, they c
		containing of their peers.		
Autonomy	Students are capable of checking their under	standing of complex concepts on their o	wn They can sn	ecify open questio
	precisely and know where to get help in solvin		with they can sp	centy open questio
	 Students can put their knowledge in relation to 			
	 Students have developed sufficient persisten 		s in a goal-orien	ted manner on ha
	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
-	General Engineering Science (German program, 7 se			
Following Curricula	General Engineering Science (German program, 7 se	mester): Specialisation Advanced Materia	als: Elective Com	pulsory
	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Engineering Science: Specialisation Advanced Materi			
	Engineering Science: Specialisation Electrical Engine Computer Science in Engineering: Core Qualification:			
	Logistics and Mobility: Specialisation Engineering Sci			
	Logistics and Mobility: Specialisation Engineering Sci Logistics and Mobility: Specialisation Information Tec			
	Orientation Studies: Core Qualification: Elective Com			
	Theoretical Mechanical Engineering: Core Qualificatio			
	5			

Course L0777: Stochastics		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	ndependent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Matthias Schulte	
Language	DE/EN	
Cycle	SoSe	
Content	 Definitions of probability, conditional probability Random variables Independence Distributions and density functions Characteristics: expectation, variance, standard deviation, moments Multivariate distributions Law of large numbers and central limit theorem Basic notions of stochastic processes Basic concepts of statistics (point estimators, confidence intervals, hypothesis testing) 	
Literature	 L. Dümbgen (2003): Stochastik für Informatiker, Springer. HO. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg. A.N. Shiryaev (2012): Problems in probability, Springer. 	

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

Courses				
Courses				
Title Automata Theory and Formal Langu	upgos (10222)	Typ Lecture	Hrs/wk 2	CP 4
Automata Theory and Formal Langi Automata Theory and Formal Langi		Recitation Section (small)	2	2
Module Responsible				
Admission Requirements				
	Participating students should be able to			
Knowledge	· · · · · · · · · · · · · · · · · · ·			
	 specify algorithms for simple data structure 	s (such as, e.g., arrays) to solve computational p	roblems	
	- apply propositional logic and predicate logic	for specifying and understanding mathematical	proofs	
	 apply the knowledge and skills taught in the 	e module Discrete Algebraic Structures		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students can explain syntax, semantics, an	d decision problems of propositional logic, and	they are able to	o give algorithms
	solving decision problems. Students can sh	now correspondences to Boolean algebra. Stud	ents can descril	be which applicat
	problems are hard to represent with propo	sitional logic, and therefore, the students can	motivate predica	ate logic, and def
	syntax, semantics, and decision problems f	or this representation formalism. Students can	explain unificatio	on and resolution
	solving the predicate logic SAT decision prob	lem. Students can also describe syntax, semanti	cs, and decision	problems for vari
	kinds of temporal logic, and identify their	application areas. The participants of the cour	se can define va	arious kinds of fi
	automata and can identify relationships to	logic and formal grammars. The spectrum that	at students can	explain ranges f
	deterministic and nondeterministic finite a	utomata and pushdown automata to Turing m	nachines. Studer	nts can name th
		re expressive than determinism. They are also		
		addition, students can transform decision proble		
		rstand that some formalisms easily induce algori		
		Students can describe the relationships betweer	n formalisms such	n as logic, autom
	or grammars.			
Skills	Students can apply propositional logic as we	Il as predicate logic resolution to a given set of fr	ormulas Student	s analyze applicat
SKIIS	s Students can apply propositional logic as well as predicate logic resolution to a given set of formulas. Students analyze applicatio problems in order to derive propositional logic, predicate logic, or temporal logic formulas to represent them. They can evaluat			
	which formalism is best suited for a particular application problem, and they can demonstrate the application of algorithms for			
		ents can also transform nondeterministic autom		
	grammars from automata and vice versa.	They can show how parsers work, and they ca	n apply algorith	ms for the langu
	emptiness problem in case of infinite words.			
Devecuel Commetence				
Personal Competence				
Social Competence	• Students are able to work together in	teams. They are capable to use mathematics as	a common langu	age.
	 In doing so, they can communicate ne 	ew concepts according to the needs of their coop	perating partners	. Moreover, they
	design examples to check and deepen	the understanding of their peers.		
Autonomy				
Autonomy	 Students are capable of checking the 	r understanding of complex concepts on their o	wn. They can sp	
	precisely and know where to get help			ecify open questi
		in solving them.		ecify open questi
		in solving them. ersistence to be able to work for longer period	s in a goal-orien	
	 Students have developed sufficient p problems. 	5	s in a goal-orien	
Workload in Hours	problems.	ersistence to be able to work for longer period	s in a goal-orien	
Workload in Hours Credit points	problems. Independent Study Time 124, Study Time in	ersistence to be able to work for longer period	s in a goal-orien	
	problems. Independent Study Time 124, Study Time in 6	ersistence to be able to work for longer period	s in a goal-orien	
Credit points Course achievement	problems. Independent Study Time 124, Study Time in 6	ersistence to be able to work for longer period	s in a goal-orien	
Credit points Course achievement	problems. Independent Study Time 124, Study Time in 6 None Written exam	ersistence to be able to work for longer period	s in a goal-orien	
Credit points Course achievement Examination	problems. Independent Study Time 124, Study Time in 6 None Written exam	ersistence to be able to work for longer period	s in a goal-orien	
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	ory and Formal Languages	
	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Matthias Mnich	
Language	EN	
Cycle	SoSe	
Content		
	1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF	
	2. Predicate logic, unification, predicate logic resolution	
	3. Temporal Logics (LTL, CTL)	
	4. Deterministic finite automata, definition and construction	
	5. Regular languages, closure properties, word problem, string matching	
	6. Nondeterministic automata:	
	Rabin-Scott transformation of nondeterministic into deterministic automata	
	7. Epsilon automata, minimization of automata,	
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)	
	8. Myhill-Nerode Theorem:	
	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 expressi	
	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, pumpi	
	lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars a back)	
	12. Chomsky normal form	
	13. CYK algorithm for deciding the word problem for context-free grammrs	
	14. Deterministic pushdown automata	
	15. Deterministic 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, verificat	
	w.r.t. temporal logic specifications (in particular LTL)	
	21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic	
	22. Fixed points, propositional mu-calculus	
	23. Characterization of regular languages by monadic second-order logic (MSO)	
Literature	1. Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.	
	 Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006 	
	 Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010. 	
	 Grundkurs rheorensene informatik, Gottined Vossen, Kureonien Witt, Vieweg-Venag, 2010. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007 	

Course L0507: Automata The	urse L0507: Automata Theory and Formal Languages		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Matthias Mnich		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0803: Embe	dded Systems				
Courses					
Title		Тур	Hrs/wk	СР	
Embedded Systems (L0805)		Lecture	3	3	
Embedded Systems (L2938)		Project-/problem-based Learning	1	1	
Embedded Systems (L0806)		Recitation Section (small)	1	2	
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous	Computer Engineering				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results			
Professional Competence					
Knowledge	Embedded systems can be defined as information processing systems embedded into enclosing products. This course teaches t foundations of such systems. In particular, it deals with an introduction into these systems (notions, common characteristics) a their specification languages (models of computation, hierarchical automata, specification of distributed systems, task graph specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time capable communicati hardware, embedded processors, memories, energy dissipation, reconfigurable logic and actuators. The course also features introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedde systems using hardware/software co-design (hardware/software partitioning, high-level transformations of specifications, energy efficient realizations, compilers for embedded processors) is covered.				
Skills	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize whic relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall b able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge i which areas of embedded system design specific risks exist.				
Personal Competence					
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.				
Autonomy	Students are able to acquire new knowledge from specific li	terature and to associate this knowle	dge with other	classes.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	Compulsory Bonus Form Description Yes 10 % Subject theoretical and practical work				
Examination	Written exam				
	90 minutes, contents of course and labs				
scale					
	General Engineering Science (German program, 7 semester		ompulsory.		
Following Curricula	Computer Science: Specialisation I. Computer and Software Electrical Engineering: Core Qualification: Elective Compuls				
		-			
	Engineering Science: Specialisation Mechatronics: Elective Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory				
	Aircraft Systems Engineering: Core Qualification: Elective Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Elective Compulsory				
	Computer Science in Engineering: Core Qualification: Compulsory				
	Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory				
	Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory				
Course L0805: Embedded Sy	stems				
Тур	Lecture				
Hrs/wk	3				
CP	3				
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
	Prof. Heiko Falk				

Lecturer	Prof. Heiko Falk
Language	EN
Cycle	SoSe
Content	 Introduction Specifications and Modeling Embedded/Cyber-Physical Systems Hardware System Software Evaluation and Validation Mapping of Applications to Execution Platforms Optimization
Literature	 Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2 nd Edition, Springer, 2012., Springer, 2012.

Course L2938: Embedded Sy	stems
Тур	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	EN
Cycle	SoSe
Content	 Introduction Specifications and Modeling Embedded/Cyber-Physical Systems Hardware System Software Evaluation and Validation Mapping of Applications to Execution Platforms Optimization
Literature	 Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2 nd Edition, Springer, 2012., Springer, 2012.

ourse L0806: Embedded Systems		
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	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Fitle		Тур	Hrs/wk	СР
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements				
Recommended Previous				
Knowledge	 Mathematik I + II for Engineering Students ((german or english) or Analysis & Linear Alg	gebra I + II for Te	echnomathematici
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence	Students are able to			
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root findin problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 			
Skills	 Students are able to implement, apply and compare numerical m justify the convergence behaviour of numer select and execute a suitable solution approx 	ical methods with respect to the problem a	nd solution algori	ithm,
Personal Competence				
Social Competence	Students are able to			
	 work together in heterogeneously compose explain theoretical foundations and support 			
Autonomy	Students are capable			
	to assess whether the supporting theoreticato assess their individual progess and, if new		individually or in	n a team,
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
	General Engineering Science (German program, 7	semester): Specialisation Computer Science	e: Compulsory	
Assignment for the		semester): Specialisation Biomedical Engin		251
Assignment for the Following Curricula			eeningi eeninpuise	
			l Engineering E	
	General Engineering Science (German program		l Engineering, F	
	General Engineering Science (German program Compulsory	n, 7 semester): Specialisation Mechanica		Focus Biomechan
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Course L0417: Numerical Ma	thematics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sabine Le Borne
Language	EN
Cycle	WiSe
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer

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

Module M0731: Funct	ional Programming				
Courses					
Title			Тур	Hrs/wk	СР
Functional Programming (L0624)			Lecture	2	2
Functional Programming (L0625)			Recitation Section (large)	2	2
Functional Programming (L0626)			Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp				
Admission Requirements	None				
Recommended Previous	Discrete mathematics at high-	school level			
Knowledge					
Educational Objectives	After taking part successfully,	students have reache	d the following learning results		
Professional Competence					
Knowledge	Students apply the principles,	constructs, and simple	e design techniques of functional progra	amming. They dem	nonstrate their abili
	to read Haskell programs and	to explain Haskell syr	ntax as well as Haskell's read-eval-print	loop. They interpr	et warnings and fir
	errors in programs. They app	y the fundamental da	ata structures, data types, and type co	onstructors. They e	employ strategies f
			or partial and total correctness. They di		
	strategies.			5	
Skills	Students break a natural-language description down in parts amenable to a formal specification and develop a functional program				
	in a structured way. They assess different language constructs, make conscious selections both at specification and				
	implementations level, and ju	stify their choice. The	y analyze given programs and rewrite	them in a controll	ed way. They desig
	and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.				
Demonstration of the second					
Personal Competence					-
Social Competence			peers. They explain problems and solu	utions to their pee	er. They defend the
	programs orally. They commu	licate in English.			
Autonomy	In programming labs, studen	s learn under superv	vision (a.k.a. "Betreutes Programmiere	n") the mechanics	of programming.
			dependently, and receive feedback.	. ,	p g
Workload in Hours	Independent Study Time 96, S	tudy Time in Lecture 8	34		
Credit points	6				
Course achievement	Compulsory Bonus Form		Description		
	Yes 15 % Excerc	ses			
	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Computer Scier	nce: Elective Comp	ulsory
Following Curricula	Computer Science: Core Quali	ication: Compulsory			
	Data Science: Core Qualificati	n: Elective Compulsor	ry		
	Data Science: Specialisation I.	Mathematics/Compute	er Science: Elective Compulsory		
	Engineering Science: Specialis	ation Mechatronics: El	ective Compulsory		
			mester): Specialisation Mechatronics: El	ective Compulsorv	
			omputer Science: Elective Compulsory		
	Technomathematics: Specialis				
	recinomacientatics, specialis	acion n. informatics: E			

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

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

Courses				
Title Introductory Seminar Computer Science I (L2362)		Typ Seminar	Hrs/wk 2	СР 3
Introductory Seminar Computer Sci		Seminar	2	3
Module Responsible				-
	None			
Admission Requirements		nd Mathamatics at the Dashelavis lovel		
Recommended Previous Knowledge	Basic knowledge of Computer Science a	nu Mathematics at the bachelor's level.		
5	After taking part successfully, students	have reached the following learning results		
Educational Objectives	After taking part successfully, students i	have reached the following learning results		
Professional Competence	The students are able to			
Knowledge	The students are able to			
	 explicate a specific topic in the field 	eld of Computer Science,		
	 describe complex issues, 			
	 present different views and evalu 	ate in a critical way.		
Skills	The students are able to			
	 familiarize in a specific topic of Co 	omputer Science in limited time		
		specific topic and cite in a correct way,		
	 elaborate a presentation and give 			
	 sum up the presentation in 10-15 			
	answer questions in the final disc			
Personal Competence				
Social Competence	The students are able to			
	 elaborate and introduce a topic for 	or a certain audience.		
		ucture of the presentation with the instructor,		
	 discuss certain aspects with the a 			
	as the lecturer listen and respond			
Autonomv	The students are able to			
	define the task in question in an a			
	 develop the necessary knowledge 			
	 use appropriate work equipment, 			
	 guided by an instructor critically of 	LIIECK LIIE WORKING STATUS.		
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination duration and	X			
scale				
Assignment for the	General Engineering Science (German n	rogram, 7 semester): Specialisation Computer S	Science: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: C		Lister Listerie comp	
this carried	Data Science: Core Qualification: Compu			
	Data Science: Core Qualification: Compu			
	Computer Science in Engineering: Core	-		

Course L2362: Introductory	Seminar Computer Science I
Тур	Seminar
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dozenten des SD E
Language	DE/EN
Cycle	WiSe/SoSe
Content	
Literature	

Course L2361: Introductory	Course L2361: Introductory Seminar Computer Science II	
Тур	Seminar	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dozenten des SD E	
Language	DE/EN	
Cycle	WiSe/SoSe	
Content		
Literature		

Courses						
Fitle			Тур		Hrs/wk	СР
Computer Architecture (L0793)			Lecture		2	3
Computer Architecture (L0794)			Project-,	problem-based Learning	2	2
Computer Architecture (L1864)			Recitatio	on Section (small)	1	1
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended Previous	Module "Computer E	ngineering"				
Knowledge						
Educational Objectives	After taking part suc	cessfully, students have i	eached the following learni	ng results		
Professional Competence						
	various programmin processors). Next, fo so-called pipelining a	ng models is given, bot bundational aspects of the and the methods used fo	m the discipline of compu- h for general-purpose cor e micro-architecture of proc or the acceleration of instru- anch prediction, supersca	nputers and for specia essors are covered. Here oction execution used in	al-purpose ma e, the focus pa this context.	achines (e.g., sig articularly lies on The students get
581115	models. The students analyze them w.r.t. c	s examine various structu criteria like, e.g., perform	ation of processors. They kn ures of pipelined processor ance or energy efficiency. T able to distinguish between	architectures and are ab They evaluate different s	le to explain t structures of n	heir concepts and nemory hierarchi
Personal Competence						
Social Competence	Students are able to	solve similar problems al	one or in a group and to pr	esent the results accord	ingly.	
Autonomy	Students are able to	acquire new knowledge f	rom specific literature and	to associate this knowle	dge with othe	r classes.
Workload in Hours	Independent Study T	Time 110, Study Time in L	ecture 70			
Credit points	6					
Course achievement	Compulsory Bonus No 15 %	Form Subject theoretical practical work	Description and			
Examination	Written exam					
Examination duration and scale	90 minutes, contents	s of course and 4 attestat	ions from the PBL "Comput	er architecture"		
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Specialisat	ion Computer Science: E	lective Compu	llsory
Following Curricula	Computer Science: S	Specialisation I. Computer	and Software Engineering:	Elective Compulsory		
	Aircraft Systems Eng	jineering: Core Qualificati	on: Elective Compulsory			
	1					
	Computer Science in	I Engineering: Specialisat	on I. Computer Science: Ele	ective Compulsory		

Course L0793: Computer Arc	hitecture
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	 Introduction VHDL Basics Programming Models Realization of Elementary Data Types Dynamic Scheduling Branch Prediction Superscalar Machines Memory Hierarchies The theoretical tutorials amplify the lecture's content by solving and discussing exercise sheets and thus serve as exam preparation. Practical aspects of computer architecture are taught in the FPGA-based PBL on computer architecture whose attendance is mandatory.
Literature	 D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.

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

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Internet S		Lecture	3	5
Computer Networks and Internet S		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	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain important and	common Internet protocols in detail and classify	/ them, in order t	to be able to analy
	and develop networked systems in further s	studies and job.		
Skille	Students are able to apply so common inter	net protocols and evaluate the use of them in diffe	aront domains	
SKIIIS	Students are able to analyse common inten	net protocols and evaluate the use of them in unit	erent domains.	
Personal Competence				
Social Competence				
A	Chudanta and aslast value at a state at a f h			and the dependence of the
Autonomy	Students can select relevant parts out of high	gh amount of professional knowledge and can ind	ependently learn	and understand it.
	Students can select relevant parts out of his Independent Study Time 124, Study Time in		ependently learn	and understand it.
	Independent Study Time 124, Study Time ir		ependently learn	and understand it.
Workload in Hours	Independent Study Time 124, Study Time ir 6		ependently learn	and understand it.
Workload in Hours Credit points Course achievement	Independent Study Time 124, Study Time ir 6		ependently learn	and understand it.
Workload in Hours Credit points Course achievement	Independent Study Time 124, Study Time in 6 None Written exam		ependently learn	and understand it.
Workload in Hours Credit points Course achievement Examination	Independent Study Time 124, Study Time in 6 None Written exam		ependently learn	and understand it.
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in 6 None Written exam 120 min	n Lecture 56		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in 6 None Written exam 120 min	n Lecture 56 ram, 7 semester): Specialisation Computer Science		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in 6 None Written exam 120 min General Engineering Science (German prog	n Lecture 56 ram, 7 semester): Specialisation Computer Science		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics Data Science: Core Qualification: Elective C	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory lective Compulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics Data Science: Core Qualification: Elective C Electrical Engineering: Core Qualification: E	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory lective Compulsory al Engineering: Elective Compulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics Data Science: Core Qualification: Elective C Electrical Engineering: Core Qualification: E Engineering Science: Specialisation Electric	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory lective Compulsory al Engineering: Elective Compulsory ronics: Elective Compulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics Data Science: Core Qualification: Elective C Electrical Engineering: Core Qualification: E Engineering Science: Specialisation Electric Engineering Science: Specialisation Mechat Engineering Science: Specialisation Mechat	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory lective Compulsory al Engineering: Elective Compulsory ronics: Elective Compulsory	e: Elective Comp	ulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time ir 6 None Written exam 120 min General Engineering Science (German prog Computer Science: Core Qualification: Com Data Science: Specialisation I. Mathematics Data Science: Core Qualification: Elective C Electrical Engineering: Core Qualification: E Engineering Science: Specialisation Electric Engineering Science: Specialisation Mechat Engineering Science: Specialisation Mechat	n Lecture 56 ram, 7 semester): Specialisation Computer Science pulsory /Computer Science: Elective Compulsory ompulsory lective Compulsory al Engineering: Elective Compulsory ronics: Elective Compulsory ronics: Elective Compulsory am, 7 semester): Specialisation Mechatronics: Ele	e: Elective Comp	ulsory

ourse L1098: Computer Net	works and Internet Security
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann, DrIng. Koojana Kuladinithi
Language	EN
Cycle	WiSe
Content	In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs. In the second part of the lecture an introduction to Internet security is given. This class comprises: • Application layer protocols (HTTP, FTP, DNS) • Transport layer protocols (TCP, UDP) • Network Layer (Internet Protocol, routing in the Internet) • Data link layer with media access at the example of Ethernet • Multimedia applications in the Internet • Network management • Internet security: IPSec • Internet security: Firewalls
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 Net	Course L1099: Computer Networks and Internet Security	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Statistics (L2430)		Lecture	3	4
Statistics (L2431)		Recitation Section (small)	1	2
	Prof. Matthias Schulte			
Admission Requirements	None			
	Stochastics (or a comparable class)			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge		tistics. They are able to evaluin them usin	a annuantista au	amalaa
	Students can name the basic concepts in Sta			
	Students can discuss logical connections be	tween these concepts. They are capable	or muscrating th	ese connections w
	the help of examples.			
Skills				
	 Students can model statistical problems with 			, they are capable
	solving them by applying established metho	ds. They are able to use the statistical soft	ware R.	
	 Students are able to discover and verify furt 	her logical connections between the conce	pts studied in the	e course.
	For a given problem, the students can dev	elop and execute a suitable approach, a	nd are able to c	ritically evaluate
	results.			
Personal Competence				
Social Competence				
Social Competence	 Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to preserve the students are able to work together (e.g. on the students). 		eams and to pres	
	their results appropriately (e.g. during exerc	ise class).		
	 In doing so, they can communicate new con 	cepts according to the needs of their coop	perating partners	. Moreover, they o
	design examples to check and deepen the u	nderstanding of their peers.		
Autonomy	Students are capable of checking their under	erstanding of complex concepts on their o	wn They can sn	ecify open questi
	precisely and know where to get help in solv		in ney can op	ceny open questa
	 Students can put their knowledge in relation 			
	 Students can put their knowledge in relation Students have developed sufficient persister 		in a goal orior	tod mannor on h
	problems.	ence to be able to work for longer period	is in a goal-oner	
	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Course achievement	None Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Advanced Materia	als: Elective Com	pulsory
Following Curricula	General Engineering Science (German program, 7 s	semester): Specialisation Computer Scienc	e: Elective Comp	ulsory
-	Computer Science: Specialisation II. Mathematics a			
	Data Science: Core Qualification: Compulsory	•		
	Engineering Science: Specialisation Advanced Mate	erials: Elective Compulsory		
	Logistics and Mobility: Specialisation Information To			
	Technomathematics: Specialisation I. Mathematics			
	Theoretical Mechanical Engineering: Specialisation		Compulsory	
	Engineering and Management - Major in Logistics a	•		Compulsory
	Engineering and management - Major in LOUISLICS d	ina mosiney. Specialisation mormation rec		. compuisory

Course L2430: Statistics		
Тур	Lecture	
Hrs/wk	3	
CP		
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Matthias Schulte	
Language	DE/EN	
Cycle	WiSe	
Content	 Multivariate distributions and stochastic convergence Point estimators Confidence intervals Hypothesis testing Nonparametric statistics Linear Regression Time series analysis Statistical software (R) 	
Literature	 L. Dümbgen (2016): Einführung in die Statistik, Birkhäuser. L. Dümbgen (2003): Stochastik für Informatiker, Springer. HO. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg. 	

Course L2431: Statistics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Computability and Complexity The	ory (L0166)	Lecture	2	3
Computability and Complexity The	ory (L0167)	Recitation Section (small)	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Discrete Algebraic Structures, Automata	Theory, Logic, and Formal Language Theory.		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowleage	The students known the important machine models of computability, the class of partial recursive functions, univer computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable a undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence system Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.			
Personal Competence				
Social Competence	Students are able to solve specific proble	ems alone or in a group and to present the results	accordingly.	
Autonomy	Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Computer Scie	ence: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Co	ompulsory		
	Data Science: Core Qualification: Elective	e Compulsory		
	Data Science: Specialisation I. Mathemat	ics/Computer Science: Elective Compulsory		
	Computer Science in Engineering: Specia	alisation I. Computer Science: Elective Compulsory	/	
	Technomathematics: Specialisation II. Int			

Course L0166: Computability	ourse L0166: Computability and Complexity Theory		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28		
Lecturer	NN		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature			

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

Module M0971: Opera	ating Systems			
Courses				
Title		Тур	Hrs/wk	СР
Operating Systems (L1153)		Lecture	2	3
Operating Systems (L1154)		Recitation Section (small)	2	3
Module Responsible	Prof. Volker Turau			
Admission Requirements	None			
Recommended Previous	· Object evidented programming algorithms and	data atmustures		
Knowledge				
	 Procedural programming Experience in using tools related to operating s 	wetome such as aditors, linkars, compi	lorg	
	 Experience in using tools related to operating systems such as editors, linkers, compilers Experience in using C-libraries 			
	• Experience in using c-instances			
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		stems, describe the	
process states and their transitions, and paraphrase the architectural variants of operating systems. They g		ey give examples of		
	existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads			
	onditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three			
	different scheduling algorithms.			
Skills	Students are able to use the POSIX libraries for concu	irrent programming in a correct and e	fficient way They a	are able to judge the
	s Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judg efficiency of a scheduling algorithm for a given scheduling task in a given environment.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 ser	nester): Specialisation Computer Scien	ice: Elective Comp	ulsory
Following Curricula	Computer Science: Specialisation I. Computer and Sof	tware Engineering: Elective Compulso	ry	
	Computer Science in Engineering: Specialisation I. Co	mputer Science: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Ele	ective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Software Engineering (L0627)		Lecture	2	3
Software Engineering (L0628)		Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous				
Knowledge				
	Procedural programming or Function			
	 Object-oriented programming, algori 	thms, and data structures		
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	Students explain the phases of the soft	tware life cycle, describe the fundamental ter	rminology and co	oncepts of softwa
	engineering, and paraphrase the principles	of structured software development. They give e	xamples of softwa	re-engineering tas
	of existing large-scale systems. They write	te test cases for different test strategies and o	devise specification	ons or models usi
	different notations, and critique both. The	ey explain simple design patterns and the majo	or activities in ree	quirements analys
	maintenance, and project planning.			
Skills For a given task in the software life cycle, students identify the corresponding phase and select an appropri		priate method. Th		
	choose the proper approach for quality ass	urance. They design tests for realistic systems, a	ssess the quality	of the tests, and fi
	errors at different levels. They apply an	d modify non-executable artifacts. They integ	rate components	based on interfa
	specifications.			
Personal Competence				
		explain problems and solutions to their peer. The	y communicate in	English.
			-	-
Autonomy		naterial for self study, students can assess their	level of knowled	ge continuously a
adjust it appropriately. Working on exercise problems, they receive additional feedback.				
Workload in Hours	Independent Study Time 124, Study Time ir	n Lecture 56		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes 15 % Excercises			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Specialisation Computer Science	ce: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Com	pulsory		
	Data Science: Specialisation I. Mathematics	Computer Science: Elective Compulsory		
	Computer Science in Engineering: Specialisation I. Computer Science: Elective Compulsory			
	Technomathematics: Specialisation II. Inform	matica, Elective Compulsory		

urse L0627: Software Engineering		
	Lecture	
Hrs/wk		
СР	}	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Schupp	
Language	EN	
Cycle	SoSe	
Content		
	Model-based software engineering	
	 Information modeling (use case diagrams) 	
	 Behavioral modeling (finite state machines, Petri Nets, behavioral UML diagrams) 	
	 Structural modeling (OOA, UML class diagrams, OCL) 	
	Model-based testing	
	Engineering software products	
	Agile processes	
	Architecture	
	Code-based testing	
	 System-level testing 	
	Software management	
	Maintenance	
	 Project management 	
	Software processes	
Literature	Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson 2020.	
	Kassem A. Saleh, Software Engineering, J. Ross Publishing 2009.	

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

Courses				
Title		Тур	Hrs/wk	СР
Lab Cyber-Physical Systems (L174	0)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Module "Embedded Systems"			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Cyber-Physical Systems (CPS) are tightly int	egrated with their surrounding environment, via sen	sors, A/D and	D/A converters, a
	actors. Due to their particular application ar	eas, highly specialized sensors, processors and actor	rs are commo	n. Accordingly, th
	is a large variety of different specification ap	proaches for CPS - in contrast to classical software e	ngineering ap	proaches.
	Based on practical experiments using robot	kits and computers, the basics of specification and	modelling of	CPS are taught 1
		characteristical properties) and their specification te	-	-
		tri nets, imperative approaches). Since CPS frequent		
		applications. The experiments will use state-of-the		
		to model cyber-physical models that interact with		
	actors.			
Skills	After successful attendance of the lab, stude	ents are able to develop simple CPS. They understand	the interdep	endencies betwee
	CPS and its surrounding processes which ste	m from the fact that a CPS interacts with the enviror	nment via sens	sors, A/D converte
	digital processors, D/A converters and act	ors. The lab enables students to compare modelli	ng approache	s, to evaluate th
	advantages and limitations, and to decide w	hich technique to use for a concrete task. They will	be able to app	oly these techniq
	to practical problems. They obtain first exp	eriences in hardware-related software development	, in industry-r	elevant specificat
	tools and in the area of simple control applic	ations.		
Personal Competence				
Social Competence	Students are able to solve similar problems	alone or in a group and to present the results accord	ingly.	
Autonomy	Students are able to acquire new knowledge	from specific literature and to associate this knowle	dae with other	r classes
Autonomy	Students are able to acquire new knowledge	from specific incrutate and to associate this knowle	age with other	Clusses.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Execution and documentation of all lab expe	riments		
scale				
-		am, 7 semester): Specialisation Computer Science: E	lective Compu	ulsory
Following Curricula		atics and Engineering Science: Elective Compulsory		
		tion II. Mathematics & Engineering Science: Elective	Compulsory	
	Mechatronics: Specialisation Intelligent Syste			
	Mechatronics: Specialisation System Design:	Elective Compulsory		
	Mechatronics: Technical Complementary Con	The still of Communication		

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

Specialization Mechanical Engineering

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

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

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

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

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

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

Module M0598: Mechanical Engineering: Design

C							
Courses							
Title					Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD Ir		Practical Tra	ining (L0268)		Lecture	2	1
Mechanical Design Project I (L0695					Project-/problem-based Learning	3	2
Mechanical Design Project II (L0592 Team Project Design Methodology					Project-/problem-based Learning Project-/problem-based Learning	3 2	2 1
		20160			Troject-problem-based Learning	2	1
Module Responsible		ause					
Admission Requirements	None						
Recommended Previous	 Fundan 	nentals of I	Aechanical Engineerir	ıg Design			
Knowledge	Mechar	nics					
	Fundan	nentals of I	Aaterials Science				
	 Product 	tion Engine	ering				
Educational Objections			fully shade at here a		n n la suela su na sulta		
Educational Objectives	After taking pa	art success	rully, students have r	eached the followi	ng learning results		
Professional Competence	After passing	البارية معمد الم	akudanta ara abla ta				
Knowledge	Alter passing	the module	e, students are able to				
	 explain 	design gu	delines for machinery	parts e.g. conside	ering load situation, materials an	id manufactur	ing requirements
	 describ 	e basics of	3D CAD,				
	 explain 	basics me	thods of engineering	designing.			
Skills	After passing	the module	e, students are able to	:			
Skiis	Arter pussing	the modul	, students are able to				
	 independently create sketches, technical drawings and documentations e.g. using 3D CAD, 						
	_	 design components based on design guidelines autonomously, 					
		-	ate) used components				
				eering design task	s systamtically and solution-orie	nted,	
	 apply c 	reativity te	chniques in teams.				
Personal Competence							
Social Competence	After passing	the module	e, students are able to				
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 						
			5				
Autonomv	Students are a	able					
					thods within the lectures (e.g. w	ith clickers),	
	 To solve 	e engineer	ng design tasks syste	matically.			
Workload in Hours	Independent S	Study Time	40, Study Time in Lee	cture 140			
Credit points							
Course achievement		nus F	orm	Description			
			ritten elaboration	Teamprojekt	Konstruktionsmethodik		
	Yes No	one V	ritten elaboration	Konstruktion	sprojekt 1		
	Yes No		ritten elaboration	Konstruktion	sprojekt 2		
	Yes No	one V	ritten elaboration	3D-CAD-Prak	tikum		
Examination	Written exam						
Examination duration and	180						
scale							
Assignment for the	-	-			ecialisation Mechanical Engineer		-
Following Curricula	-	-			ecialisation Biomedical Engineer		-
	-	-			ecialisation Biomedical Engineer	ring: Compulso	ory
	-	-	eering: Core Qualifica				
			ecialisation Mechatror				
			ecialisation Mechanica				
	Engineering S	cience: Sp	ecialisation Biomedica	I Engineering: Cor	npulsory		
	•						

Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	 Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings
Literature	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuell 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; Cornelse aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuell Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (10264)	Lecture	2	2
Advanced Mechanical Engineering		Recitation Section (large)	2	1
Advanced Mechanical Engineering		Lecture	2	2
Advanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Fundamentals of Mechanical Engine 	eering Design		
	Mechanics			
	 Fundamentals of Materials Science 			
	Production Engineering			
Educational Objectives	After taking part successfully, students ha	we reached the following learning results		
Professional Competence				
Knowledge	After passing the module, students are at	le to:		
	evolain complex working principles	and functions of machine elements and of basic e	lements of fluidics	
		eria, application scenarios and practical examples		
	 indicate the background of dimens 		or complex mach	ine elements,
	• Indicate the background of dimens			
Skills	Ils After passing the module, students are able to:			
	 accomplish dimensioning calculation 	ons of covered machine elements.		
		nodule to new requirements and tasks (problem s	olvina skills)	
	 recognize the content of technical 		string statis,,	
	 evaluate complex designs, technica 	5		
Personal Competence				
Social Competence	 Students are able to discuss technic 	cal information in the lecture supported by activat	ing mothods	
			ing methous.	
Autonomy	. Chudanta an abla ta indanan daath			
		deepen their acquired knowledge in exercises.		. h
		ional knowledge and to recapitulate poorly unde	rstood content e.g	g. by using the via
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time i	n Lecture 112		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120			
scale				
		gram, 7 semester): Specialisation Mechanical Eng	ineering: Compuls	ory
Following Curricula	Energy and Environmental Engineering: C			
		ry Course Core Studies: Elective Compulsory		
	Engineering Science: Specialisation Mecha			
		gram, 7 semester): Specialisation Mechanical Engi	neering: Compulso	ory
	Mechanical Engineering: Core Qualificatio			
	Naval Architecture: Core Qualification: Co	mpulsory		

Hrs/wk 2 CP 2	Lecture 2 2 2 Independent Study Time 32, Study Time in Lecture 28
CP 2	2
Workload in Hours	Independent Study Time 22, Study Time in Lecture 28
	independent Study Time 52, Study Time in Lecture 20
Lecturer a	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
1	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	• Axes & shafts
	• Seals
	Clutches & brakes
	• Belt & chain drives
	• Gear drives
	• Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
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	
	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.
S	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 Me	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	• Axes & shafts
	• Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	• Axes & shafts
	Clutches & brakes
	• Belt & chain drives
	Gear drives
	• Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
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.
	 Konstructionsleine, Fain, G., Deitz, W., Springer-Verlag, actuelle 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				
		_		
Title Fundamentals of Materials Science	1 (11095)	Typ Lecture	Hrs/wk	CP 2
	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible	Prof. lörg Weißmüller			
Admission Requirements	None			
	Highschool-level physics, chemistry und mathematics			
Knowledge	inglisenser ever physics, enemisery and matternates			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence		ing learning results		
-	The students have acquired a fundamental knowledge on r	metals, ceramics an	d polymers and can descr	ibe this knowled
	comprehensively. Fundamental knowledge here means specific			
	phase transformations, corrosion and mechanical properties. TI			
	for materials and can identify relevant approaches for cha			
	phenomena back to the underlying physical and chemical laws	of nature.		
Skills	The students are able to trace materials phenomena back t			
	phenomena here refers to mechanical properties such as stre			
	resistance, and to phase transformations such as solidificatio			
	between processing conditions and the materials microstructum aterial's behavior.	ure, and they can ac	count for the impact of mi	crostructure on t
Personal Competence				
Social Competence				
	-			
Autonomy	- Independent Study Time 06, Study Time in Lecture 94			
Workload in Hours				
Credit points				
Course achievement	None			
	Written exam			
Examination duration and	180 min			
scale				
	General Engineering Science (German program, 7 semester): S			
Following Curricula	General Engineering Science (German program, 7 semester): S			ιÿ
	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	•	1 5	
	Data Science: Specialisation II. Application: Elective Compulsor		eu Materiais. Compuisory	
	Digital Mechanical Engineering: Core Qualification: Compulsory			
	Green Technologies: Energy, Water, Climate: Specialisation Ene		ctive Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elect			
	Logistics and Mobility: Specialisation Production Management a		ve Compulsory	
	Mechanical Engineering: Core Qualification: Compulsory		1. · · · · 2	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		
			duction Management and	Drassesses Flast
	Engineering and Management - Major in Logistics and Mobili	ty: Specialisation Pro	ouccion Management and	Processes: Elect

Course L1085: Fundamentals	or Materials Science i
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471- 32013-7 P. Haasen: Physikalische Metallkunde. Springer 1994

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

Module M0680: Fluid	Dynamics			
	-			
Courses				
Title		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	Students should have sound knowledge of engineering mat	hematics, engineering mechanics	and thermodyna	nics.
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Skills	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. They are familiar with the similarities and differences between fluid mechanics and neighbouring subjects (thermodynamics, structura mechanics). Students can scientifically outline the rationale of flow physics using mathematical models. They are familiar with most performance analysis methods -in particular their realms and limitations- and the prediction of fluid engineering devices. Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. They are able			
Personal Competence	to explain physical relationships used to design fluid engineering devices. The lecture enables the student to carry out a necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.			
Social Competence	The students are able to discuss problems, present the re- address given technical goals.	sults of their own analysis, and jc	intly develop sol	ution strategies th
Autonomy	The students are able to develop solution strategies for co results as well as external data with regards to the plausibil		ney are able to c	ritically analyse ov
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	eering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architectur	e: Compulsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science	Elective Compulsory		

ourse L0454: Fluid Mechan	cs
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	 the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg.

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

Courses				
Гitle		Тур	Hrs/wk	СР
Computational Mechanics (Exercise	es) (L1138)	Recitation Section (small)	2	2
Computational Multibody Dynamics	s (L1137)	Integrated Lecture	2	2
Computational Stuctural Mechanics	; (L2475)	Integrated Lecture	2	2
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Mathematics I-III and Engineering Mechanic	5 1-111		
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure use			
	explain important steps in model des	ign;		
	 present technical knowledge. 			
Skills	The students can			
		athematical / mechanical analysis and model for	mation, and appl	y it to the context
	their own problems;			
	 apply basic methods from numerical 	mechanics to engineering problems;		
	 estimate the reach and boundaries or 	the methods and extend them to be applicable	o wider problem	sets.
Personal Competence				
	The students can work in groups and suppo	rt each other to overcome difficulties		
Social competence	The statenes can work in groups and suppo	e cuen other to overcome unrealites.		
Autonomy	Students are capable of determining their o	wn strengths and weaknesses and to organize th	eir time and learn	ing based on those
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German prog	am, 7 semester): Specialisation Mechanical Engi	neering: Compuls	orv
Following Curricula		am, 7 semester): Specialisation Biomedical Engli am, 7 semester): Specialisation Biomedical Engli		-
		ram, 7 semester): Specialisation Naval Architectu		
	Energy Systems: Technical Complementary		iei eempaisery	
	Mechanical Engineering: Core Qualification:			
	Mechatronics: Core Qualification: Compulso			
	Naval Architecture: Core Qualification: Com			
	Technomathematics: Specialisation III. Engli	-		
	Theoretical Mechanical Engineering: Technic	cal Complementary Course Core Studies: Elective	Compulsory	

Course L1138: Computationa	Il Mechanics (Exercises)
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, Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course L1137: Computationa	Il Multibody Dynamics
Тур	Integrated Lecture
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	 Linear versus nonlinear vibration Numerical methods for time integration Concepts from analytical mechanics Spatial multibody systems Linearization of multibody systems Vibrations with multiple degrees of freedom: free, damped, forced, modal transformation Impacts Introduction to Matlab
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L2475: Computationa	Il Stuctural Mechanics
Тур	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	The lecture Computational Structural Mechanics extends the content of the lecture Engineering Mechanic II. It bridges the gap between the manual calculation of mechanical stress and deformation in systems with a particularly simple geometry and the efficent computer-based computation of general mechanical systems: • Basics of linear continuum mechanics • Planar structures: plate, membrane, slab • Linientragwerke: beam, cable, truss • Weak form and Galerkin's method • Finite element method: theory and application • Principles of mechanics: principle of virtual work, virtual displacements, virtual forces
Literature	Gross, Hauger, Wriggers, "Technische Mechanik 4", Springer

Courses					
Title	d Control Systems (11110)	Typ Practical Course	Hrs/wk	CP 2	
Practical Course: Measurement and Control Systems (L1119) Measurement Technology for Mechanical Engineering (L1116)		Lecture	2	3	
Measurement Technology for Mech		Recitation Section (large)	1	1	
Module Responsible	Prof. Thorsten Kern				
Admission Requirements	None				
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering				
Knowledge					
Educational Objectives	After taking part successfully, students have re	eached the following learning results			
Professional Competence					
Knowledge	e Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, U Calibration, Static and Dynamic Properties of Sensors and Systems).				
	They can outline the most important measuri Temperature, mechanical quantities, Flow, Tir		to be maesured (Electrical Quantiti	
	They can describe important methods of chem	iical Analysis (Gas Sensors, Spectroscopy, Ga	s Chromatography)	
Skills	Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.				
	The students are able to orally explain issues in the subject area of measurement technology and solution appr place the issues into the right context and application area.				
Personal Competence					
Social Competence	Students can arrive at work results in groups and document them in a common report.				
Autonomy	Students are able to familiarize themselves wi	th new measurement technologies.			
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70			
Credit points	6				
Course achievement		Description			
	Yes None Subject theoretical	and			
	practical work				
	Subject theoretical and practical work				
Examination duration and scale	105 minutes				
	General Engineering Science (German progran	n 7 somostor): Specialisation Mechanical En	incoring: Compuls	00/	
	General Engineering Science (German program				
· · · · · · · · · · · · · · · · · · ·	General Engineering Science (German program				
	Digital Mechanical Engineering: Core Qualification: Compulsory				
	Energy and Environmental Engineering: Core C				
	Engineering Science: Specialisation Mechatronics: Compulsory				
	Engineering Science: Specialisation Mechanical Engineering: Compulsory				
	Engineering Science: Specialisation Mechanical Engineering: Compulsory				
	Engineering Science: Specialisation Biomedical Engineering. Elective Compulsory				
	General Engineering Science (English program		ompulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program	, 7 semester): Specialisation Biomedical Engi	neering: Elective C	ompulsory	
	Logistics and Mobility: Specialisation Productio	n Management and Processes: Elective Com	oulsory		
	Mechanical Engineering: Core Qualification: Co	ompulsory			
	Mechanical Engineering: Core Qualification: Co Mechatronics: Core Qualification: Compulsory	ompulsory			
			n Management and	Processes: Elect	

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

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

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

Focus Biomechanics

Module M1277: MED	I: Introduction to Anatomy			
	·			
Courses				
Title	Typ Hrs/wk CP			
Introduction to Anatomy (L0384)	Lecture 2 3			
Module Responsible	Prof. Udo Schumacher			
Admission Requirements	None			
Recommended Previous	Students can listen to the lectures without any prior knowledge. Basic school knowledge of biology, chemistry / biochemistry			
Knowledge	physics and Latin can be useful.			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
-	The lectures are about microscopic anatomy, describing the microscopic structure of tissues and organs, and about macrosc			
	anatomy which is about organs and organ systems. The lectures also contain an introduction to cell biology, human developr			
	and to the central nervous system. The fundamentals of radiologic imaging are described as well, using projectional x-ray			
	cross-sectional images. The Latin terms are introduced.			
CI-III-				
SKIIIS	At the end of the lecture series the students are able to describe the microscopic as well as the macroscopic assembly			
	functions of the human body. The Latin terms are the prerequisite to understand medical literature. This knowledge is neede understand und further develop medical devices.			
	These insights in human anatomy are the fundamentals to explain the role of structure and function for the development			
	common diseases and their impact on the human body.			
Personal Competence				
Social Competence				
	are prerequisite for communication with physicians on a professional level.			
Autonomy	The lectures are an introduction to the basics of anatomy and should encourage students to improve their knowledge			
Autonomy	themselves. Advice is given as to which further literature is suitable for this purpose. Likewise, the lecture series encoura			
	students to recognize and think critically about biomedical problems.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
	None			
Course achievement				
	Written exam			
	Written exam			
Examination	Written exam 90 minutes			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
Examination Examination duration and scale	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation II. Application: Elective Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomedical Technology: Elective Compulsory General Engineering: Specialisation Biomedical Technology Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomedical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechai Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomedical Technology: Elective Compulsory General Engineering: Specialisation Biomedical Technology Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			

urse L0384: Introduction t	o Anatomy		
Тур	Lecture		
Hrs/wk			
СР			
	dependent Study Time 62, Study Time in Lecture 28		
	rof. Tobias Lange		
Language			
Cycle			
content	General Anatomy 1 st week: The Eucaryote Cell		
	2 nd week: The Tissues		
	3 rd week: Cell Cycle, Basics in Development 4 th week: Musculoskeletal System		
	5 th week: Cardiovascular System		
	6 th week: Respiratory System		
	^h week: Genito-urinary System		
	^h week: Immune system		
	th week: Digestive System I 0 th week: Digestive System II		
	11 th week: Endocrine System		
	12 th week: Nervous System		
	13 th week: Exam		
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016		

Courses		Тур	Hrs/wk	СР	
ntroduction to Radiology and Radia	ation Therapy (L0383)	Lecture	2	3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements	None				
Recommended Previous	None				
Knowledge Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence		j			
Knowledge	Therapy				
	The students can distinguish different types of c	urrently used equipment with respect	to its use in radiation the	rapy.	
	The students can explain treatment plans used i	n radiation therapy in interdisciplinary	v contexts (e.g. surgery, i	nternal medicine).	
	The students can describe the patients' pa	ssage from their initial admittance	e through to follow-up	care.	
Diagnostics					
	-				
	The students can illustrate the technical base of well as sectional imaging techniques (CT, MRT, U		cluding anglography and	mammography, a	
	The students can explain the diagnostic as well techniques.	as therapeutic use of imaging technic	ques, as well as the tech	nical basis for thos	
	The students can choose the right treatment me	thod depending on the patient's clinic	al history and needs.		
	The student can explain the influence of technic	al errors on the imaging techniques.			
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.				
		d on the images diagnostic indings o	i the endi 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 ps groups, self-help groups, social services, psycho	ychosocial service should look like (e.g. follow-up treatment	. sports, social he	
	Diagnostics				
	The students can suggest solutions for repairs of	imaging instrumentation after baying	done error analyses		
	The students can classify results of imaging te anatomy, pathology and pathophysiology.	chniques according to different grou	ps of diseases based on	their knowledge	
Personal Competence					
Social Competence	The students can assess the special social situat The students are aware of the special, often measures and can meet them appropriately.			-	
Autonomy	The students can apply their new knowledge and	skills to a concrete therapy case			
Autonomy	The students can introduce younger students to				
	The students are able to access anatomical kno and acquire the relevant knowledge themselves		e competently in conver	sations on the top	
Workload in Hours	Independent Study Time 62, Study Time in Lectu	ire 28			
Credit points					
Course achievement					
	Written exam				
Examination	90 minutes				
Examination duration and	so minutes				
Examination duration and scale		7 semester): Specialisation Biomedica	al Engineering: Compulso	rv	
Examination duration and scale	General Engineering Science (German program,				
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory	m, 7 semester): Specialisation Me			
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory Data Science: Specialisation II. Application: Elect	m, 7 semester): Specialisation Med			
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory	m, 7 semester): Specialisation Med ive Compulsory chnology: Elective Compulsory			
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory Data Science: Specialisation II. Application: Elect Electrical Engineering: Specialisation Medical Te Engineering Science: Specialisation Biomedical E General Engineering Science (English program, 7	m, 7 semester): Specialisation Med ive Compulsory chnology: Elective Compulsory ingineering: Compulsory 7 semester): Specialisation Biomedical	chanical Engineering, F	ocus Biomechanic	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory Data Science: Specialisation II. Application: Elect Electrical Engineering: Specialisation Medical Te Engineering Science: Specialisation Biomedical E General Engineering Science (English program, Mechanical Engineering: Specialisation Biomech	m, 7 semester): Specialisation Med ive Compulsory chnology: Elective Compulsory ingineering: Compulsory 7 semester): Specialisation Biomedical anics: Compulsory	chanical Engineering, F	ocus Biomechanic	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory Data Science: Specialisation II. Application: Elect Electrical Engineering: Specialisation Medical Te Engineering Science: Specialisation Biomedical E General Engineering Science (English program, 7	m, 7 semester): Specialisation Med ive Compulsory chnology: Elective Compulsory ingineering: Compulsory 7 semester): Specialisation Biomedical anics: Compulsory fechnology and Control Theory: Electiv	chanical Engineering, F Engineering: Compulsor re Compulsory	ocus Biomechanic	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German progra Compulsory Data Science: Specialisation II. Application: Elect Electrical Engineering: Specialisation Medical Te Engineering Science: Specialisation Biomedical E General Engineering Science (English program, 7 Mechanical Engineering: Specialisation Biomech Biomedical Engineering: Specialisation Medical T	m, 7 semester): Specialisation Med ive Compulsory chnology: Elective Compulsory ingineering: Compulsory 7 semester): Specialisation Biomedical anics: Compulsory Fechnology and Control Theory: Electiv ent and Business Administration: Elec	chanical Engineering, F Engineering: Compulsor ve Compulsory ctive Compulsory	ocus Biomechanio	

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

Courses					
Fitle		Тур	Hrs/wk	СР	
Numerical Mathematics I (L0417)		Lecture	2	3	
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3	
Module Responsible	Prof. Sabine Le Borne				
Admission Requirements					
Recommended Previous					
Knowledge	 Mathematik I + II for Engineering Student basic MATLAB/Python knowledge 	s (german or english) or Analysis & Linear Ale	gebra I + II for Te	echnomathematici	
	After taking part successfully, students have rea	ached the following learning results			
Professional Competence Knowledge	Students are able to				
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root fine problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 				
Skills	Students are able to				
	 implement, apply and compare numerica justify the convergence behaviour of num select and execute a suitable solution ap 	nerical methods with respect to the problem a	nd solution algori	ithm,	
Personal Competence					
Social Competence	Students are able to				
		sed teams (i.e., teams from different study p ort each other with practical aspects regarding			
Autonomy	Students are capable				
	 to assess whether the supporting theoret to assess their individual progess and, if 	ical and practical excercises are better solved necessary, to ask questions and seek help.	l individually or ir	n a team,	
Workload in Hours	Independent Study Time 124, Study Time in Leo	ture 56			
Credit points	6				
Course achievement	None				
Exe	Written exam				
Examination					
	90 minutes				
Examination duration and					
Examination duration and scale		7 semester): Specialisation Computer Science	e: Compulsory		
Examination duration and scale Assignment for the	General Engineering Science (German program,			arv	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program,	7 semester): Specialisation Biomedical Engin	eering: Compulso		
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German progra	7 semester): Specialisation Biomedical Engin	eering: Compulso		
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German progr Compulsory	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanica	eering: Compulso Il Engineering, F	Focus Biomechan	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German progra Compulsory General Engineering Science (German program	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanica	eering: Compulso Il Engineering, F	Focus Biomechan	
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Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Elective Compulsory General Engineering Science (German program Compulsory	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanical Engi	eering: Compulso Il Engineering, F neering, Focus Th Engineering, Foc neering, Focus M	Focus Biomechan neoretical Mechan cus Aircraft Syste lechatronics: Elect	
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Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program, Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Elective Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (German program,	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical 7 semester): Specialisation Advanced Materia	eering: Compulso Il Engineering, F neering, Focus Th Engineering, Focus neering, Focus M Engineering, Focus als: Compulsory	Focus Biomechan neoretical Mechan cus Aircraft Syste lechatronics: Elect cus Energy System	
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Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Elective Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (German program, General Engineering: Specialisation A - Gene Computer Science: Specialisation II. Mathematic Data Science: Core Qualification: Electi Engineering Science: Core Qualification: Electi Engineering Science: Core Qualification: Computer Science: Core Qualification: Computer Science: Core Qualification: Computer Science: Core Qualification: Computer Science: In Engineering: Core Qualifica	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical ral Bioprocess Engineering: Elective Compulso rs and Engineering Science: Elective Compulso ve Compulsory Isory Isory ation: Compulsory	eering: Compulso I Engineering, F neering, Focus Th Engineering, Focus neering, Focus M Engineering, Foc als: Compulsory cal Engineering, ory	Focus Biomechan neoretical Mechan cus Aircraft Syste lechatronics: Elect cus Energy Syste	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Elective Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program, General Engineering: Specialisation A - Gene Computer Science: Specialisation II. Mathematic Data Science: Core Qualification: Electi Engineering Science: Core Qualification: Electi Engineering Science: Core Qualification: Computer Science: Nore Qualification: Computer Science: Nore Qualification: Computer Science: Core Qualification: Computer Science: In Engineering: Core Qualification Computer Science in Engineering: Core Qualification Computer Science in Engineering: Core Qualification Mechanical Engineering: Specialisation Theoretic	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical 8 and Engineering: Elective Compulso 9 and Engineering Science: Elective Compulso 9 sory 9	eering: Compulso I Engineering, F neering, Focus Th Engineering, Focus neering, Focus M Engineering, Foc als: Compulsory cal Engineering, ory	Focus Biomechan neoretical Mechan cus Aircraft Syste lechatronics: Elect cus Energy Syste	
Examination duration and scale Assignment for the	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Elective Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (German program, General Engineering: Specialisation A - Gene Computer Science: Specialisation II. Mathematic Data Science: Core Qualification: Electi Engineering Science: Core Qualification: Electi Engineering Science: Core Qualification: Computer Science: Core Qualification: Computer Science: Core Qualification: Computer Science: Core Qualification: Computer Science: In Engineering: Core Qualifica	7 semester): Specialisation Biomedical Engin am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical sourcess Engineering: Elective Compulso sources Engineering: Elective Compulso sources Server lsory ation: Compulsory cal Mechanical Engineering: Compulsory systems: Elective Compulsory	eering: Compulso I Engineering, F neering, Focus Th Engineering, Foc neering, Focus M Engineering, Foc als: Compulsory cal Engineering, ory ory	Focus Biomechan neoretical Mechan cus Aircraft Syste lechatronics: Elect cus Energy Syste	

Course L0417: Numerical Ma	thematics I		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	rof. Sabine Le Borne		
Language	N		
Cycle	WiSe		
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss guadrature, adaptive guadrature 		
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer 		

Course L0418: Numerical Ma	ourse L0418: Numerical Mathematics I		
Тур	citation Section (small)		
Hrs/wk			
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne, Dr. Jens-Peter Zemke		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and M	olecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	describe basic biomolecules;	is association the DNA.		
	explain how genetic informationexplain the connection between			
	• explain the connection between	DNA and proteins,		
Skills	The students can			
	 recognize the importance of mol 	ecular parameters for the course of a disease;		
	describe selected molecular-diag			
	 explain the relevance of these p 			
Personal Competence				
Social Competence	The students can participate in discuss	ions in research and medicine on a technical lev	el.	
	Students will have an improved under	rstanding of current medical problems (e.g. Co	orona pandemic)and wil	be able to expla
	these issues to others.			
Autonomy	The students can develop an understar	nding of topics from the course, using technical l	iterature, by themselves	5.
	Students will be better equipped to rec	ognize fake news in the media regarding medica	al research topics	
Workload in Hours	Independent Study Time 62, Study Tim	e in Lecture 28		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Biomedical	Engineering: Compulso	ry
Following Curricula	General Engineering Science (Germa	an program, 7 semester): Specialisation Mec	hanical Engineering, F	ocus Biomechani
	Compulsory			
	Electrical Engineering: Specialisation M	ledical Technology: Elective Compulsory		
	Engineering Science: Specialisation Bio	medical Engineering: Compulsory		
		rogram, 7 semester): Specialisation Biomedical	Engineering: Compulsor	У
	Mechanical Engineering: Specialisation			
		Management and Business Administration: Elect		
		Artificial Organs and Regenerative Medicine: Ele		
		Medical Technology and Control Theory: Elective		
		Implants and Endoprostheses: Elective Compuls Engineering Science: Elective Compulsory	or y	
	. cellionacienacies. specialisadori III.	Engineering science. Liective compulsoly		

Course L0386: Introduction t	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:	Implants and Fracture Healing	g			
	-	-			
Courses					
Title		Тур	Hrs/wk	СР	
Implants and Fracture Healing (L03	76)	Lecture	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous	It is recommended to participate in "Introdu-	ction into Anatomie" before attending "Impl	ants and Fracture Heali	ng".	
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	The students can describe the different way	s how bones heal, and the requirements for	their existence.		
	The students can name different treatments	for the spine and hollow bones under giver	n fracture morphologies		
Skills	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.				
Personal Competence				·	
•	The students can in groups, solve basis pur	norical modeling tacks for the calculation of	internal forces		
Social Competence	The students can, in groups, solve basic nun	nerical modeling tasks for the calculation of	internal forces.		
Autonomy	The students can, in groups, solve basic num	nerical modeling tasks for the calculation of	internal forces.		
Workload in Hours	Independent Study Time 62, Study Time in L	Lecture 28			
Credit points	3				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Mech	nanical Engineering, F	ocus Biomechanic	
Following Curricula	Compulsory				
	General Engineering Science (German progr	am, 7 semester): Specialisation Biomedical	Engineering: Compulso	ry	
	Engineering Science: Specialisation Biomedi	cal Engineering: Compulsory			
	General Engineering Science (English progra	am, 7 semester): Specialisation Biomedical B	Engineering: Compulsor	У	
	Mechanical Engineering: Specialisation Biom	nechanics: Compulsory			
	Biomedical Engineering: Specialisation Impla	ants and Endoprostheses: Elective Compulse	ory		
	Biomedical Engineering: Specialisation Artifi	cial Organs and Regenerative Medicine: Ele	ctive Compulsory		
	Biomedical Engineering: Specialisation Mana	agement and Business Administration: Elect	ive Compulsory		
	Biomedical Engineering: Specialisation Medi		Compulsory		
	Orientation Studies: Core Qualification: Elect	tive Compulsory			
	Technomathematics: Specialisation III. Engin	neering Science: Elective Compulsory			

Course L0376: Implants and	Fracture Healing
Тур	Lecture
	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	
Cycle	
Content	Topics to be covered include: 1. Introduction (history, definitions, background importance)
	 Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
	 Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine
	3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
	5 Fracture Healing
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates
	5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
Literature	Cochran V.B.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

Courses					
Title	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, dev	elopme			
	of forces and vital functions) and relate them to similar technical systems.				
Personal Competence					
Social Competence	The students can conduct discussions in research and medicine on a technical level.				
	The students can find solutions to 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 liter	rature,			
	themselves.				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Credit points					
Course achievement					
Examination					
scale	oo mindes				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biom	echanio			
Ū.	Compulsory				
	Data Science: Specialisation Medicine: Compulsory				
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory				
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory				
	Mechanical Engineering: Specialisation Biomechanics: Compulsory				
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory				
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory				
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory				
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory				

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

Courses	
Title	Typ Hrs/wk CP
Experimental Methods in Biomecha	
Module Responsible	Prof. Michael Morlock
Admission Requirements	
Recommended Previous	
Knowledge	······································
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
	1. Tribology
	2. Optical Methods
	3. Motion Analysis
	4. Pressure Distribution
	5. Strain Gauges
	6. Pre-clinical testing
	7. Specimen Preparation and Storage
	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.
	The students can describe different measurement techniques for forces and movements, and choose the adequate technique f given task.
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.
Personal Competence	
Social Competence	Students are able to organize themselves as a group to solve simple experimental tasks together. On the one hand, the division tasks must be organized during the experiment as well as during the short written elaboration, but on the other hand, knowledge acquired must be available to all participants of the group afterwards. The challenge here is that the topics characterize fundamentally different measurement principles are taught. In addition, a strict time management is expected
Autonomy	Students perform simple experimental tasks in small groups or create simple sensors (e.g. strain gauges). The preceding lec serves as a basis for these experiments. As preparation or follow-up, the theoretical knowledge has to be worked up and relate the experimental result. In particular, independent transfer performance is necessary to clarify why experimental observations show deviations from the theoretical values and how these deviations can be compensated.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Course achievement	None
Examination	Written exam
Examination duration and	90 min
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
Following Curricula	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Technomathematics: Specialisation III. Engineering Science: 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	The course deals with common experimental methods used in biomechanics. For each topic an overview and some basic practical knowledge is provided. 1. Tribology 2. Optical Methods 3. Motion Analysis 4. Pressure Distribution 5. Strain Gauges 6. Pre-clinical testing 7. Specimen Preparation and Storage
Literature	Hoffmann K., Eine Einführung in die Technik des Messens mit Dehnmessstreifen White A.A., Panjabi M.M.: Clinical biomechanics of the spine Nigg, B.: Biomechanics of the musculo-skeletal system Online Hilfe von Mathworks: https://de.mathworks.com/help/matlab/

Module M0934: Adva	nced Materials for Sustainab	ility		
Courses				
Title		Түр	Hrs/v	wk CP
Advanced Materials Characterization	an (L1087)	Lecture	2	2 2
Advanced Materials for Sustainabil		Lecture	2	2
Advanced Materials for Sustainabil		Recitation Se	ction (large) 2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements				
Recommended Previous	Fundamentals of Materials Science (I and)		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning re	sults	
Professional Competence				
-	The students will be able to explain the p metallic, ceramic, polymeric, semiconduc The students will be able to select mat	tor, modern composite materials (bio	omaterials) and nanomate	erials.
300	The students will be able to select material configurations according to the technical needs and, if necessary, to design ne materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview o modern materials science, which enables them to select optimum materials combinations depending on the technical applications			
Personal Competence				
Social Competence	The students are able to present solution	s to specialists and to develop ideas	further.	
Autonomy	The students are able to • assess their own strengths and we • define tasks independently.	aknesses.		
Workload in Hours	Independent Study Time 96, Study Time i	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German	program 7 semester): Specialisat	tion Mechanical Enginee	ring Focus Biomechanic
Following Curricula	5 5 .	program, , semester, specialisa	ion ricentanear Englitee	inig, rocus biomeename
y carrieda	General Engineering Science (German pro	ogram, 7 semester): Specialisation A	dvanced Materials: Compu	ulsory
	General Engineering Science (German			
	Engineering Sciences: Compulsory			
	Engineering Science: Specialisation Mech	anical Engineering: Elective Compute	orv	
	Engineering Science: Specialisation Adva			
	Mechanical Engineering: Core Qualification			

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

Course L1091: Advanced Ma	Course L1091: Advanced Materials for Sustainability		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Patrick Huber, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature	Vorlesungsunterlagen		

Course L1092: Advanced Ma	terials for Sustainability
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 Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses					
Title			Тур	Hrs/wk	СР
	rogramming Concepts, Data Handling & Communical	ion (L2689)	Lecture	3	3
	rogramming Concepts, Data Handling & Communicat		Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle				
Admission Requirements					
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ached the follow	ving learning results		
Professional Competence	· · · · · · · · · · · · · · · · · · ·				
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 110, Study Time in Leo	ture 70			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 10 % Attestation	l'estate find	den semesterbegleitend statt.		
	Written exam				
Examination duration and	120 min				
scale	Coursel Engineering Colours (Courses			. Fasia saisa - F	Diana diana diana di
Following Curricula	General Engineering Science (German progr Compulsory	am, 7 semest	er): Specialisation Mechanica	i Engineering, r	OCUS BIOMECHANIC
Following curricula	General Engineering Science (German program,	7 comester). S	Specialisation Biomedical Engin	eering: Compuls	arv
	General Engineering Science (German program,				
	Compulsory	, semester, s			uble Energy: Elect
	General Engineering Science (German progra	m, 7 semester	r): Specialisation Mechanical I	Engineering, Foc	us Energy Systen
	Compulsory			5 5.	5, ,
	General Engineering Science (German progra	m, 7 semeste	r): Specialisation Mechanical	Engineering, Foo	us Aircraft System
	Engineering: Compulsory				
	General Engineering Science (German progr	am, 7 semest	er): Specialisation Mechanica	l Engineering,	Focus Mechatroni
	Compulsory				
	General Engineering Science (German program	, 7 semester):	Specialisation Mechanical Eng	neering, Focus F	Product Developme
	and Production: Elective Compulsory				
	General Engineering Science (German program,				
	General Engineering Science (German program	, 7 semester): 9	Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechani
	Engineering: Elective Compulsory				
	Bioprocess Engineering: Core Qualification: Con				
	Chemical and Bioprocess Engineering: Core Qua		puisory		
	Electrical Engineering: Core Qualification: Comp Green Technologies: Energy, Water, Climate: Sp		aray Systems: Elective Comput	sony	
	Logistics and Mobility: Specialisation Informatio			SULY	
	Mechatronics: Core Qualification: Compulsory	recinology: (compulsory		
	Process Engineering: Core Qualification: Compulsory	lsory			
	Engineering and Management - Major in Logistic		Specialisation Information Too	hnology: Comput	sory
	Engineering and Management - Major III Logistic	.5 and mobility.	specialisation mornation rec	mology. compu	3013

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

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

Focus Energy Systems

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

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

Module M0684: Heat	Transfer					
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						
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics					
Knowledge	After taking part successfully, students have reached the fe	llowing loorning roculto				
Educational Objectives Professional Competence	After taking part successfully, students have reached the fo	nowing learning results				
•						
Khomeage	The students can					
	- explain the technical terms,					
	- classify the various physical processes of heat transfer in	terms of conduction-based and rad	iation-based mec	hanisms,		
	simplify and critically analyze complex heat transfer proce	accos using models				
	- simplify and critically analyze complex heat transfer proce	sses using models,				
	- methodically develop solutions to tasks.					
Skills	The students are able to					
	describe the physics of the different Heat Transfer macha	aicm				
	- describe the physics of the different Heat Transfer mechanism,					
	- simplifywith models, calculate and evaluate complex Heat Transfer processes,					
	- critically question and answer statements on heat transfer,					
	- solve excersises self-consistent and in small groups.					
Personal Competence						
	In lectures and exercises, the students can use many ex-	amples and experiments to discus	s in small group	s in a goal-oriented		
···· /···	manner, develop a solution and present it. Within the exe					
	work out targeted solutions.					
Autonomy	The students can check their level of knowledge by means	of repetition questions at the begir	ning of the lectur	es and describe an		
	discuss answers in exchange with the other students. In the	e exercises, the students work in sr	mall groups on the	e methods taught ir		
	the lectures in complex tasks and critically analyze the resu	Ilts in the auditorium.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points						
Course achievement						
Examination						
Examination duration and	120 min					
scale	Concert Facilitation Colonea (C	atau) Curraialianti Marti I				
Assignment for the Following Curricula	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical E	ngineering, Focu	s Energy Systems		
ronowing curricula		r): Specialisation Biomedical Engine	ering: Compulso	7		
		an program, 7 semester): Specialisation Biomedical Engineering: Compulsory an program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical				
	Engineering: Compulsory	., selansadon ricenamear Engin				
	Energy Systems: Technical Complementary Course Core St	udies: Elective Compulsory				
	Integrated Building Technology: Core Qualification: Comput					
	Mechanical Engineering: Specialisation Energy Systems: Co	mpulsory				
	l					

Hechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, Heat Conduction (steady and unsteady) , Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

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

Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0633)		Lecture	1	1	
Fundamentals of Reciprocating Eng	ines and Turbomachinery - Part Reciprocating Engines (L0634)	Recitation Section (large)	1	1	
Internal Combustion Engines I (L0059)		Lecture	2	2	
Internal Combustion Engines I (L06	39)	Recitation Section (large)	1	2	
	Prof. Christopher Friedrich Wirz				
Admission Requirements	None				
Recommended Previous	Thermodynamics, Mechanics, Machine Elements				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results			
Professional Competence					
Knowledge	As a result of the part module "Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals power and working machinery and describe the qualitative and quantitative correlations of operating methods and effic multiple types of engines, compressors and pumps. They are able to utilize technical terms and parameters as well a regarding the development of power density and efficiency, furthermore to give an overview of charging systems, emissions. The students are able to select specific types of machinery and assess design related and operational problem				
Skills	As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-are 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 system 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 a thermodynamic design.				
Personal Competence Social Competence	The students are able to communicate and cooperate in application.	a professional environment in	the field of ma	achinery design a	
Autonomy	The widespread scope of gained knowledge enables the stuc confidently.	dents to handle situations in thei	r future professio	on independently a	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement					
Examination					
Examination duration and					
	120 (1)(1)				
scale	Constant Englisher Colones (C		Factoria E		
Assignment for the	General Engineering Science (German program, 7 semest	ter): Specialisation Mechanical	Engineering, Foc	us Energy Syster	
Following Curricula					
	Energy and Environmental Engineering: Core Qualification: E				
	Energy Systems: Technical Complementary Course Core Stud				
	Green Technologies: Energy, Water, Climate: Specialisation E	Energy Technology: Elective Com	pulsory		

rse L0633: Fundamentals	of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines		
Тур	Lecture		
Hrs/wk	1		
CP			
Workload in Hours	dependent 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 		
Literature	Einteilung und Verwendung A. Urlaub: Verbrennungsmotoren W. Kalide: Kraft- und Arbeitsmaschinen		

ourse L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines		
Тур	Recitation Section (large)	
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	Cycle WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0059: Internal Comb	Course L0059: Internal Combustion Engines I		
Тур	Lecture		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wolfgang Thiemann		
Language	DE		
Cycle	SoSe		
Content	 The beginnings of engine development Design of of motors Real process calculation Charging methods Kinematics of the crank mechanism Forces in the engine 		
Literature	 Vorlesungsskript Übungsaufgaben mit Lösungsweg Literaturliste 		

Course L0639: Internal Comb	ourse L0639: Internal Combustion Engines I		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Wolfgang Thiemann		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses			
Title	Typ Hrs/wk CP		
Numerical Mathematics I (L0417)			
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3		
Module Responsible	e Prof. Sabine Le Borne		
Admission Requirements	s None		
Recommended Previous			
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomather basic MATLAB/Python knowledge 	matici	
Educational Objectives	s After taking part successfully, students have reached the following learning results		
Professional Competence	e		
Knowledge	e Students are able to		
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root find problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 		
Skills	/s Students are able to		
	 implement, apply and compare numerical methods using MATLAB/Python, justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, select and execute a suitable solution approach for a given problem. 		
Personal Competence	e		
Social Competence	e Students are able to		
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background kno explain theoretical foundations and support each other with practical aspects regarding the implementation of algor 		
Autonomy	y Students are capable		
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team, to assess their individual progess and, if necessary, to ask questions and seek help. 		
Workload in Hours	s Independent Study Time 124, Study Time in Lecture 56		
Credit points	·s 6		
Course achievement	tt None		
Examination	n Written exam		
Examination duration and	d 90 minutes		
Examination duration and scale	e		
Examination duration and scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory		
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory 	echani	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometering 	echani	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometer 		
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometering 		
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Metodeta 	echan	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Meteory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Meteory 	echani	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometone Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometone Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Metone Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft 	echan Syste	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometon Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biometon Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Meton Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective Compulsory 	echan Syste	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Meters Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft 	echan Syste : Elect	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomet Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Meters Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory 	echan Syste : Elect	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective 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 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 Mechatronics: 	echan Syste : Elect	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft 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 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 Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy S Elective Compulsory 	echan Syste : Elect Syster	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective 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 Energy S Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy S Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Foc	echan Syste : Elect Syster	
Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Engineering: Elective 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 Energy S Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering S	echan Syste : Elect Syster	
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Course L0417: Numerical Ma	Course L0417: Numerical Mathematics I		
Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne		
Language	EN		
Cycle	WiSe		
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 		
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 		

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

Courses				
		T	Have for de	67
Fitle Computational Fluid Dynamics I (LC	1235)	Typ Lecture	Hrs/wk 2	CP 3
Computational Fluid Dynamics I (LC		Recitation Section (large)	2	3
Module Responsible		-		
Admission Requirements	None			
	Students should have sound knowledge of engineering mathematics (series expansions, internal & vector calculus), and be famil			
	with the foundations of partial/ordinary differential equations. They should also be familiar with engineering fluid mechanics ar thermodynamics.			
Educational Objections				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence	Students will have the required combined k			
	principles of thermo-/fluid engineering into discrete algorithms on the basis of local (finite differences/volumes) and glot (potential theory) ansatz functions. They are familiar with the similarities and differences between different discretisation are approximation concepts for investigating coupled systems of non-linear, convective partial differential equations (PDE), an explain the motivation for applying them. Students have the required background knowledge to develop, code, explain and appr numerical algorithms dedicated to the solution of thermofluid dynamic PDEs. They are familiar with most numerical methods use to predict thermofluid dynamic fields, in particular their realms and limitations.			
Skills	The students are able choose and apply appropriate numerical procedures that integrate the governing thermofluid dynamic PD in space and time. They can apply/optimise numerical analysis concepts to/for fluid dynamic applications. They can co computational algorithms in a structured way, apply these codes for parameter investigations and supplement interfaces extract simulation data for an engineering analysis.			
Personal Competence Social Competence	The students are able to discuss problems, present the results of their own analysis, and jointly develop, implement and report solution strategies that address given technical reference problems.			
Autonomy	The students can independently analyse numerical methods to solving fluid engineering problems. They are able to critic analyse own results as well as external data with regards to the plausibility and reliability.			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement				
Examination duration and scale	Written exam 2h			
Assignment for the Following Curricula		m, 7 semester): Specialisation Naval Architectu ram, 7 semester): Specialisation Mechanical	ire: 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 Formulation of boundary conditions and initial conditions Assembly and solution of algebraic equation systems Facets of weighted -residual approaches Finite volume methods Basics of grid generation 	
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer	

Course L0419: Computationa	Irse 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				
Title		Тур	Hrs/wk	СР
Electrical Machines and Actuators ((L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular comp	lexe numbers, integrals, differentials		
Knowledge	Basics of electrical engineering and mechanical engineering			
Educational Objectives				
	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence Knowledge	Students can to draw and explain the basi	c principles of electric and magnetic fields.		
		standard types of electric machines and p		
		rives they can explain the major parameters of	the energy efficiency	of the whole system
	from the power grid to the driven engine.			
Skills	Students are able to calculate two-dimen	sional electric and magnetic fields in particula	ar ferromagnetic circ	uits with air gap. I
	this they apply the usual methods of the d	esign auf electric machines.		
	They can calulate the operational perform	nance of electric machines from their given c	haracteristic data an	d selected quantiti
		usual equivalent circuits and graphical methods		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calcul	ate electric and magnatic fields for application	is. They are able to a	nalyse independer
	the operational performance of electric m	nachines from the charactersitic data and the	ycan calculate thered	of selected quantit
	and characteristic curves.			
	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
Course achievement				
Examination				
	Design of four machines and actuators, re-	view of design files		
scale			nin e nin n. Ele etito Ce	
		gram, 7 semester): Specialisation Electrical Eng program, 7 semester): Specialisation Mechani		
Following Curricula	Compulsory	rogram, 7 semester). Specialisation Mechani	ical Engineering, Foo	Lus Ellergy Syster
		program, 7 semester): Specialisation Mecha	anical Engineering.	Focus Mechatroni
	Compulsory		, j, j,	
	General Engineering Science (German pro	gram, 7 semester): Specialisation Mechanical I	Engineering, Focus Th	heoretical Mechani
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qual	ification: Compulsory		
	Electrical Engineering: Core Qualification:	Elective Compulsory		
	Engineering Science: Specialisation Electri	cal Engineering: Elective Compulsory		
		te: Specialisation Energy Technology: Elective	Compulsory	
	Logistics and Mobility: Specialisation Engin			
		ic Planning and Systems: Elective Compulsory		
	Logistics and Mobility: Specialisation Produ	uction Management and Processes: Elective Co	mpulsory	
	Machanical Engineering, Corre Overliff, 11	-		
	Mechanical Engineering: Core Qualification	n: Elective Compulsory		
	Mechatronics: Core Qualification: Compuls	n: Elective Compulsory sory		
	Mechatronics: Core Qualification: Compuls Technomathematics: Specialisation III. Eng	n: Elective Compulsory sory gineering Science: Elective Compulsory	ning and Systems: El	ective Compulsor
	Mechatronics: Core Qualification: Compuls Technomathematics: Specialisation III. Eng Engineering and Management - Major in Lo	n: Elective Compulsory sory		

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

Course L0294: Electrical Mac	hines and Actuators
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses						
Title				Тур	Hrs/wk	СР
Computer Science for Engineers - P	Programming Concepts, D	ata Handling & Communication	(L2689)	Lecture	3	3
Computer Science for Engineers - P	Programming Concepts, D	ata Handling & Communication	(L2690)	Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part succ	essfully, students have reache	ed the followi	ing learning results		
Professional Competence						
Knowledge						
Skills						
Devenuel Commetence						
Personal Competence						
Social Competence Autonomy						
	Indonondont Study Tir	ne 110, Study Time in Lectur	0.70			
Credit points	6	The 110, Study Time in Lectury	e 70			
	Compulsory Bonus	Form	Description			
Course achievement	No 10 %			en semesterbegleitend statt.		
Examination	Written exam			5		
Examination duration and	120 min					
scale						
Assignment for the	General Engineering	Science (German program,	7 semeste	r): Specialisation Mechanica	l Engineering, F	ocus Biomechani
Following Curricula					5 5.	
		Science (German program, 7 s	emester): Sp	ecialisation Biomedical Engin	eering: Compulso	ory
	General Engineering S	cience (German program, 7 s	emester): Sp	ecialisation Green Technologi	es, Focus Renew	able Energy: Elect
	Compulsory					
	General Engineering	Science (German program,	7 semester)	: Specialisation Mechanical I	Engineering, Foc	us Energy System
	Compulsory					
			7 semester)	: Specialisation Mechanical	Engineering, Foc	us Aircraft System
	Engineering: Compuls					
		Science (German program,	, 7 semeste	r): Specialisation Mechanica	l Engineering, I	ocus Mechatroni
	Compulsory					
			semester): S	pecialisation Mechanical Engi	ineering, Focus P	roduct Developme
	and Production: Electi		omostor): Sn	ecialisation Electrical Enginee	ring: Elective Co	mpulcon
				pecialisation Mechanical Engire		
	Engineering: Elective		serifester). Sp	Sectorisation Mechanical Engli	leening, rocus m	
		g: Core Qualification: Compul	sorv			
		ess Engineering: Core Qualific	-	ulsory		
		: Core Qualification: Compulse		-		
				rgy Systems: Elective Compul	sory	
	-	Specialisation Information Te			-	
	Mechatronics: Core Qu	ualification: Compulsory				
	Process Engineering:	Core Qualification: Compulsor	У			
	Engineering and Mans	where the second s	and Markelline of	Specialisation Information Tec		

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

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

Title Typ Hrs/wk CP Paneer industry (10316) Lecture 1 1 Renerable Energy (10313) Lecture 2 2 Renerable Energy (10314) Lecture 2 2 Module Responsible Prof. Martin Katschmitt 1 1 Admission Requirements None 2 2 Recommended Previous Are taking part successfully, students have reached the following learning results 2 Professional Competence Knowledge With completion of this module, the students can provide an overview of characteristics of energy systems and their econdition and power trading with regard to subject-related contexts. The students can explain the issues occurring in this torely. There was and critical discuss them. Furtherm the students can explain the issue occurring in this to subject-related contexts. The students can explain the issue occurring in this to subject-related contexts. The students can explain the issue occurring in this to subject-related contexts. The students can explain the issue occurring in this discuss them. Furtherm the students are able to apply methodologies for detailed determination of energy demand or energy production for various typ energy systems. Furthermore, they can choose the necessary subject-specific calculation rules, also for standardized solutions of a problem. The students are able to apply methodologies for detailed determination of energy demand or energy production for various typ ene	Courses					
Energy Systems and Energy (10313) Lecture 2 2 Renewable Energy (10313) Recitation Section (small) 1 1 Module Responsible Forf. Martin Kaltschmitt Recitation Section (small) 1 1 Admission Requirements Ione	Title		Тур	Hrs/wk	СР	
Renewable Energy (12133) Lecture 2 2 Renewable Energy (12133) Pof. Martin Kaltschmitt 1 1 1 Module Responsible Pof. Martin Kaltschmitt None Image: Comparison of the Comparison of	Power Industry (L0316)		Lecture	1	1	
Renewable Energy (1143) Recitation Section (small) 1 Module Responsible Prof. Martin Kaltschmitt Mane Admission Requirements None Ince Recommended Previous none Ince Forfossional Objectives After taking part successfully, students have reached the following learning results Ince Professional Competence Knowledge With completion of this module, the students can provide an overview of characteristics of energy systems and their econ distribution and power trading with regard to subject-related contexts. The students can explain these aspects, which applicable to many energy systems in general, especially for renewable energy systems and critical discuss them. Furtherm the students can explain the environmental benefits from the use of such systems. Skills Students are able to apply methodologies for detailed determination of energy demand or energy production rules, also for standardized solutions of a problem. The students are able to apply methodologies for detailed determination of energy demand or energy production rules, also for standardized solutions of a problem. Automore The students are able to apply and possible approaches to its processing from the field of renewable energies or and to put them them into the right context. Personal Competence Social Competence The students are able to analyze suitable technical alternatives and to assess them with technical,	Energy Systems and Energy Indust	y (L0315)	Lecture	2	2	
Module Responsible Prof. Martin Kaltschmitt Admission Requirements None Recommended Previous Knowledge Inone Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge With completion of this module, the students can provide an overview of characteristics of energy systems and their econ efficiency. They can explain the issues occurring in this context. Furthermore, they can explain dealies of power generation, pr distribution and power trading with regard to subject-related contexts. The students can explain these aspects, which applicable to many energy systems in general, especially for reverable energy systems and critical discuss them. Furthern the students can explain the environmental benefits from the use of such systems. Skills Students are able to apply methodologies for detailed determination of energy demand or energy production for various typ energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design 1 under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies of and to put them them into the right context. Personal Competence Social Competence The students are able to analyze suitable technical alternatives and to assess them with technical, economical and ecolor criteria under	Renewable Energy (L0313)		Lecture	2	2	
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Following Carricula Elective Compulsory				Engineering, 10		
Energy and Environmental Engineering: Core Qualification: Compulsory	Following Curricula					

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

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

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

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

Focus Aircraft Systems Engineering

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

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

Module M0596: Adva	
Courses	
Title Advanced Mechanical Design Proje	Typ Hrs/wk CP ct (L0266) Project-/problem-based Learning 4 6
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous Knowledge	 Mechanical Engineering: Design Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	After passing the module, students are able to: • express the procedure for systematically handling of • complex design tasks , • describe working principles, their use and combination possibilities, • explain guidelines for designing for function and manufacturing,
Skills	 explain advanced use-oriented knowledge of machine elements. After passing the module, students are able to: analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, use methods to design and solve engineering design tasks systematically and solution-oriented, create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail.
Personal Competence Social Competence	After passing the module, students are able to: present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course
Autonomy	 After passing the module, students are able to: independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecti appropriate methods, to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Yes None Attestation
Examination	
Examination duration and	180
scale Assignment for the Following Curricula	

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
Content	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.
	Getriebekonstruktion in Einzelarbeit
	Erarbeitung von Lösungsprinzipien
	Berechnung von Maschinenelementen
	Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
	Erstellung einer ausführlichen Dokumentation
	Lösungsfindung
	 Methodische Erarbeitung von prinzipiellen Lösungskonzepten
	Erstellen einer Dokumentation
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

Courses				
		T	Have for de	67
Title Computational Fluid Dynamics I (L0235)		Typ Lecture	Hrs/wk	СР 3
Computational Fluid Dynamics I (L0419)		Recitation Section (large)	2	3
Module Responsible		-		
Admission Requirements	None			
	Students should have sound knowledge of end	gineering mathematics (series expansions, inte	ernal & vector calc	ulus), and be fami
	with the foundations of partial/ordinary different thermodynamics.			
Educational Objections				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence	Students will have the required combined k			
	(potential theory) ansatz functions. They are approximation concepts for investigating co explain the motivation for applying them. Stu	discrete algorithms on the basis of local (f e familiar with the similarities and difference: pupled systems of non-linear, convective pa- idents have the required background knowled n of thermofluid dynamic PDEs. They are fami- cular their realms and limitations.	s between differe tial differential e ge to develop, coo	nt discretisation a quations (PDE), a le, explain and ap
Skills	in space and time. They can apply/optimis computational algorithms in a structured wa	students are able choose and apply appropriate numerical procedures that integrate the governing thermofluid dynamic pace and time. They can apply/optimise numerical analysis concepts to/for fluid dynamic applications. They can putational algorithms in a structured way, apply these codes for parameter investigations and supplement interfa act simulation data for an engineering analysis.		
Personal Competence Social Competence	The students are able to discuss problems, pr solution strategies that address given technica		ntly develop, impl	ement and report
Autonomy	The students can independently analyse nur analyse own results as well as external data w		problems. They	are able to critic
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
Assignment for the Following Curricula		m, 7 semester): Specialisation Naval Architectu ram, 7 semester): Specialisation Mechanical	ire: Compulsory	-

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

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

Courses						
Title	Тур	Hrs/wk	СР			
Numerical Mathematics I (L0417)	Lecture	2	3			
Numerical Mathematics I (L0418)	Recitation Section (small)	2	3			
Module Responsible	Prof. Sabine Le Borne					
Admission Requirements	None					
Recommended Previous						
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Alg basic MATLAB/Python knowledge 	gebra I + II for Te	echnomathematici			
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional Competence						
Knowledge	Students are able to					
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root findir problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 					
Skills	Students are able to					
	 implement, apply and compare numerical methods using MATLAB/Python, justify the convergence behaviour of numerical methods with respect to the problem a select and execute a suitable solution approach for a given problem. 	nd solution algor	ithm,			
Personal Competence						
Social Competence	Students are able to					
	 work together in heterogeneously composed teams (i.e., teams from different study prexplain theoretical foundations and support each other with practical aspects regarding 					
Autonomy	Students are capable					
	 to assess whether the supporting theoretical and practical excercises are better solved to assess their individual progess and, if necessary, to ask questions and seek help. 	l individually or in	n a team,			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	90 minutes					
scale						
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science	e: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engin		ory			
j	General Engineering Science (German program, 7 semester): Specialisation Mechanica	5 1	5			
	Compulsory	5 5,				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	neering, Focus Tl	heoretical Mechan			
		5.				
	Engineering: Compulsory					
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical	Engineering, Fo	cus Aircraft Syste			
		Engineering, Fo	cus Aircraft Syste			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical					
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engi	neering, Focus M	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory	neering, Focus M	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engi Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I	neering, Focus M Engineering, Foo	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engi Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory	neering, Focus M Engineering, Foc als: Compulsory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engi Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia	neering, Focus M Engineering, Foc als: Compulsory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engi Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia	neering, Focus M Engineering, Foo als: Compulsory cal Engineering,	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	neering, Focus M Engineering, Foo als: Compulsory cal Engineering, ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	neering, Focus M Engineering, Foc als: Compulsory cal Engineering, ory ory	lechatronics: Elect			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsor Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsor Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	neering, Focus M Engineering, Foc als: Compulsory cal Engineering, ory ory	lechatronics: Elect			

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

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

Courses						
Title		Тур	Hrs/wk	СР		
Simulation and Design of Mechatro	nic Systems (L1822)	Lecture	2	2		
Simulation and Design of Mechatronic Systems (L1823)		Recitation Section (large)	1	2		
Simulation and Design of Mechatronic Systems (L1824) Practical Course 1 2				2		
Module Responsible	NN					
Admission Requirements	None	None				
Recommended Previous	Fundatmentals of mechanics, control theor	y and electrical engineering				
Knowledge						
Educational Objectives	After taking part successfully, students have	ve reached the following learning results				
Professional Competence						
Knowledge	Students are able to describe methods and	calculations for design, modeling, simulation and	optimization of n	nechatronic systen		
Skills	Skills Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulate					
	systems and implement those in laboratory conditions.					
Personal Competence						
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.					
Autonomy	Students are able to recognize and improve knowledge deficits independently.					
	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.					
Workload in Hours	Independent Study Time 124, Study Time i					
Credit points						
Course achievement	None					
Examination	Written exam					
Examination duration and	90 min					
scale	50 1111					
	General Engineering Science (German pro	gram, 7 semester): Specialisation Mechanical Eng	ineering Focus M	lechatronics: Elect		
Following Curricula	Compulsory	grant, 7 semester). Specialisation meenanical Engl	incernig, rocus in	Leet		
i onothing curricula		rogram, 7 semester): Specialisation Mechanical	Engineering For	rus Aircraft Syste		
	Engineering: Elective Compulsory		, 100	see and and by see		
	Digital Mechanical Engineering: Core Quali	fication: Compulsory				
	Mechanical Engineering: Specialisation Airo					
	Mechanical Engineering: Specialisation Me					
	Mechatronics: Core Qualification: Compulse					

Course L1822: Simulation and Design of Mechatronic Systems		
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design	
	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab $^{\circledast}$ and Simulink $^{\circledast}$	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	

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

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

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

Module M0599: Integ	rated Product Dev	velopment and	Lightweigh	t Design		
Courses						
Title				Тур	Hrs/wk	СР
CAE-Team Project (L0271)				Project-/problem-based Learning	2	2
Development of Lightweight Design Products (L0270)				Lecture	2	2
Integrated Product Development I	L0269)			Lecture	2	2
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous	s Advanced Knowledge about engineering design:					
Knowledge	Fundamentals of Mechanical Engineering Design					
	Mechanical Engineering:	Design				
	Advanced Mechanical En	gineering Design				
Educational Objectives	After taking part success	fully, students have r	eached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the mod	dule, students are cap	able of:			
	 explaining the fundamental 	ctional principle of 3D	-CAD-Systems, PD	M- and FEM-Systems		
	 describing the interview 	raction of the differe	nt CAE-Systems in	the product development proces	55	
CI-III-						
Skills						
	After completing the mod	dule, students are abl	e to:			
	product structuring	g		to the desired requirements su A-Systems with shared workload	ıch as classifi	cation schemes and
Personal Competence						
-	After completing the mod	ule students are abl	e to:			
Social competence	Arter completing the mot					
	To develop a projePresent project res			vork packages in the framework action	of group discu	issions
Autonomy	Students are capable of					
Autonomy	Students are capable of:					
	 independently ada 	pt to a CAE-Tool and	complete a given	practical task with it		
Workload in Hours	Independent Study Time	96. Study Time in Le	ture 84			
Credit points	6	er, otaay nine in Lev				
Course achievement		orm	Description			
	Yes 20 % Su	ubject theoretical	andCAE-Teampre	ojekt inkl. Vortrag und Ausarbeitu	ung	
	pr	actical work				
Examination	Written exam					
Examination duration and scale	90					
Assignment for the	General Engineering Sci	ence (German prog	am, 7 semester)	: Specialisation Mechanical End	ineering, Foc	us Aircraft Systems
-	Engineering: Compulsory			-	-	-
_			m, 7 semester): S	pecialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compuls	ory				
	Engineering Science: Spe	cialisation Mechanica	I Engineering: Ele	ctive Compulsory		
	General Engineering Scie	nce (English program	, 7 semester): Spe	ecialisation Mechanical Engineeri	ng: Elective Co	ompulsory
	Mechanical Engineering:	Specialisation Produc	t Development an	d Production: Compulsory		
	Mechanical Engineering:	•				
	Product Development, Ma	aterials and Productio	n: Technical Com	plementary Course Core Studies:	Elective Com	pulsory

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L	0925)	Lecture	2	3
Quality Management (L0926)		Lecture	2	3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the conten	ts of the lecture of the module.		
Skills	Students are able to apply the methods	and models in the module to industrial problem	1S.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mecha	inical Engineering, Foc	us Aircraft Syster
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mechanica	al Engineering, Focus P	roduct Developme
	and Production: Compulsory			
	General Engineering Science (German p	rogram, 7 semester): Specialisation Advanced I	Materials: Elective Com	pulsory
	Engineering Science: Core Qualification	Compulsory		
	Engineering Science: Specialisation Med	hatronics: Elective Compulsory		
	Engineering Science: Specialisation Med	hanical Engineering: Elective Compulsory		
	Engineering Science: Specialisation Adv			
		oduction Management and Processes: Compulso	ory	
	Logistics and Mobility: Specialisation En			
	Mechanical Engineering: Core Qualificat	ion: Elective Compulsory		
	Engineering and Management - Major in	Logistics and Mobility: Specialisation Productio	n Management and Pro	cesses: Compulsor

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

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

Module M0767: Aeror	nautical 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 t	thermodynamics			
Knowledge					
Educational Objectives	After taking part successfully, students h	have reached the followin	g learning results		
Professional Competence					
Knowledge	Students get a basic understanding of	the structure and design	of an aircraft, as well as a	an overview of th	he systems inside
	aircraft. In addition, a basic knowledge of	of the relationchips, the k	ey parameters, roles and wa	ays of working in	different subsyster
	in the air transport is acquired.				
Skills	Due to the learned cross-system think	king students can gain a	a deeper understanding of	different system	n concepts and th
	technical system implementation. In addition, they can apply the learned methods for the design and assessment of sub-			nent of subsystems	
	the air transportation system in the cont	text of the overall system		-	-
Personal Competence					
Social Competence	Students are made aware of interdisciplinary communication in groups.				
Autonomy	Students are able to independently an	nalyze different system o	oncepts and their technica	l implementation	n as well as to thi
,	system oriented.	, ,			
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84			
Credit points	6				
Course achievement					
Examination	Written exam				
Examination duration and	150 min				
scale					
Assignment for the	General Engineering Science (German	program, 7 semester):	Specialisation Mechanical	Engineering, Foo	cus Aircraft Syste
Following Curricula					,
	Logistics and Mobility: Specialisation Log	gistics and Mobility: Electi	ve Compulsory		
	Logistics and Mobility: Specialisation Tra				
	Mechanical Engineering: Specialisation A				
	Engineering and Management - Major in	, 5	5 1 5	and Systems: Fl	ective Compulsory
	Engineering and Hanagement - Major In	- Logistics and mobility. Sp		ana Systems. El	ceare compained y

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

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

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

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

Courses						
Title				Tum	Hrs/wk	СР
Computer Science for Engineers - F	Programming Concepts, Data Ha	andling & Communication ((12689)	Typ Lecture	3	3
Computer Science for Engineers - F		-		Recitation Section (small)	2	3
Module Responsible		-				
Admission Requirements	-					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part successful	v. students have reache	d the followi	ng learning results		
Professional Competence	······ ·······························	,,				
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Time 11	0, Study Time in Lecture	e 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description	and the second second second second second		
		station 1	l estate finde	en semesterbegleitend statt.		
Examination	Written exam					
Examination duration and	120 min					
scale	Concerl Frazina ania a Coice		7	a) Canadaliantina Manhanina	L Facilitation - F	Diana diana diana di
Following Curricula		ice (German program,	/ semester	r): Specialisation Mechanica	ii Engineering, r	ocus Biomechanic
Following curricula	Compulsory	e (German program 7 se	omostor): Sn	ecialisation Biomedical Engin	eering: Compuls	Nrv
				ecialisation Green Technolog		
	Compulsory	e (eerman program, , ee	emester, op		ies, i ocus iterien	able Energy: Elect
		ce (German program, 7	7 semester):	Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory				5 5.	5, ,
	General Engineering Scien	ce (German program, 7	7 semester)	: Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Compulsory					
	General Engineering Scier	ice (German program,	7 semeste	r): Specialisation Mechanica	al Engineering, I	Focus Mechatroni
	Compulsory					
	General Engineering Science	e (German program, 7 s	semester): S	pecialisation Mechanical Eng	ineering, Focus F	roduct Developme
	and Production: Elective Co	mpulsory				
				ecialisation Electrical Engine		
			emester): Sp	pecialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Elective Comp	-				
	Bioprocess Engineering: Col		-	ulcon		
	Chemical and Bioprocess Er Electrical Engineering: Core			uisoi y		
				rgy Systems: Elective Compul	lsory	
	Logistics and Mobility: Spec				isor y	
	Mechatronics: Core Qualifica		ciniology. Ct	mpuisory		
	Process Engineering: Core Q		4			
				Specialisation Information Tec	hnology: Comput	sorv
	and manageme					

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

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

itle iodeling, Simulation and Optimization Module Responsible Pr Admission Requirements N		Тур		
Module Responsible Pr			Hrs/wk	СР
-		Integrated Lecture	4	6
Admission Requirements N	of. Benedikt Kriegesmann			
/ annobien negationen a	one			
Recommended Previous So	ound knowledge of engineering mathem	atics, engineering mechanics and fluid mechanic	S	
Knowledge				
Educational Objectives Af	ter taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge St	udents will have an overview of variou	s technical problems and the differential equation	ons, which describe	them. Students
ga	ave an overview of different solution app	proaches and for which kind of problems they car	1 be used for.	
<i>skills</i> st	udents are able to solve different techn	ical problems with the introduced discretization r	methods	
Personal Competence				
Social Competence Th	ne students are able to discuss problems	s and jointly develop solution strategies.		
Autonomy Th	he students are able to develop solution	strategies for complex problems self-consistent	and critically analyse	results
Workload in Hours In	dependent Study Time 124, Study Time	in Lecture 56		
Credit points 6				
Course achievement N	one			
Examination O	ral exam			
Examination duration and 30) min			
scale				
Assignment for the G	eneral Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanical Er	ngineering, Focus Th	eoretical Mechar
Following Curricula En				
		ogram, 7 semester): Specialisation Advanced Mat		
G	eneral Engineering Science (German	program, 7 semester): Specialisation Mechanic	al Engineering, Foc	us Aircraft Syste
Er	ngineering: Elective Compulsory			
Er	ngineering Science: Core Qualification: C	Compulsory		
м	echanical Engineering: Specialisation Th	eoretical Mechanical Engineering: Compulsory		

Course L2446: Modeling, Simulation and Optimization (EN)		
Тур	Integrated Lecture	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried	
Language	EN	
Cycle	SoSe	
Content	 Partial Differential Equations in technical problems Overview of modelling approaches Finite Approximation Methods - Finite Differences / Elements / Volumes Introduction to the Discrete Element Method Numerical methods for time dependent problems Gradient-based optimization 	
Literature	Michael Schäfer, Computational Engineering - Introduction to Numerical Methods, Springer.	

Focus Mechatronics

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

Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
	Prof. Alexander Kölpin			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculat	ting electrical circuits. They know	w the Fourier ser	ies analysis of linea
	networks driven by periodic signals. They know the metho	ds for transient analysis of linea	ar networks in tir	me and in frequence
	domain, and they are able to explain the frequency behavior	ur and the synthesis of passive tv	vo-terminal-circui	ts.
Skills	The students are able to calculate currents and voltages	in linear networks by means of	basic methods,	also when driven b
	periodic signals. They are able to calculate transients in elec	trical circuits in time and frequer	icy domain and a	re able to explain t
	respective transient behaviour. They are able to analyse	and to synthesize the frequency	y behaviour of p	assive two-termina
	circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small guided groups.	They are encouraged to present	and discuss the	eir results within th
	group.			
Autonomy	The students are able to find out the required methods for s	solving the given practice probler	ms. Possibilities a	re given to test the
	knowledge during the lectures continuously by means of	f short-time tests. This allows	them to control	independently the
	educational objectives. They can link their gained knowledge	e to other courses like Electrical E	ingineering I and	Mathematics I.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanica	al Engineering. I	Focus Mechatronic
Following Curricula			5	
	General Engineering Science (German program, 7 semester)	: Specialisation Electrical Engine	ering: Compulsor	/
	Electrical Engineering: Core Qualification: Compulsory			
	Engineering Science: Specialisation Electrical Engineering: C	ompulsory		
	Computer Science in Engineering: Specialisation II. Mathema		ive Compulsory	
	Mechatronics: Core Qualification: Compulsory		. ,	
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

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

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. Alexander Kölpin, Dr. Fabian Lurz
Language	DE
Cycle	WiSe
Content	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
Literature	- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)
	- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)
	- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)
	- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

urse L0567: Circuit Theory	
Recitation Section (small)	
2	
2	
Independent Study Time 32, Study Time in Lecture 28	
Prof. Alexander Kölpin, Dr. Fabian Lurz	
DE	
WiSe	
see interlocking course	
siehe korrespondierende Lehrveranstaltung	

Courses				
Title		Тур	Hrs/wk	СР
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2	2
Simulation and Design of Mechatro	nic Systems (L1823)	Recitation Section (large)	1	2
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theo	ry and electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods an	d calculations for design, modeling, simulation and	optimization of n	nechatronic system
Skills		hms for modeling of mechatronic systems. They ca	n identify, simula	ate and design sim
	systems and implement those in laborator	ry conditions.		
Personal Competence				
•	Students are able to work goal-oriented in small mixed groups and present results to target groups.			
, · · · · ·				
Autonomy	Students are able to recognize and improv	ve knowledge deficits independently.		
	With instructor assistance students are a	ble to evaluate their own knowledge level and defin	e a further cours	e of study
Workload in Hours	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study. Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination duration and	Written exam			
	90 1111			
scale				ta ala ata ani an indiana
-		ogram, 7 semester): Specialisation Mechanical Engi	ineering, Focus M	lechatronics: Elect
Following Curricula	Compulsory	The second se	Facility of the Fac	
		program, 7 semester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Syste
	Engineering: Elective Compulsory	ification Computern		
	Digital Mechanical Engineering: Core Qual			
	Mechanical Engineering: Specialisation Air			
	Mechanical Engineering: Specialisation Me			

Course L1822: Simulation an	Course L1822: Simulation and Design of Mechatronic Systems	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design	
	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab $^{\circledast}$ and Simulink $^{\circledast}$	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	

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

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

Courses			
Title	Тур	Hrs/wk	СР
Numerical Mathematics I (L0417)	Lecture	2	3
Numerical Mathematics I (L0418)	Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne		
Admission Requirements	None		
Recommended Previous			
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Alg basic MATLAB/Python knowledge 	gebra I + II for Te	echnomathematici
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to		
	 name numerical methods for interpolation, integration, least squares problems, eigenv problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to compute 		
Skills	Students are able to		
	 implement, apply and compare numerical methods using MATLAB/Python, justify the convergence behaviour of numerical methods with respect to the problem ar select and execute a suitable solution approach for a given problem. 	nd solution algor	ithm,
Personal Competence			
Social Competence	Students are able to		
	 work together in heterogeneously composed teams (i.e., teams from different study pr explain theoretical foundations and support each other with practical aspects regarding 		
Autonomy	Students are capable		
	 to assess whether the supporting theoretical and practical excercises are better solved to assess their individual progess and, if necessary, to ask questions and seek help. 	individually or in	n a team,
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and	90 minutes		
scale			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engine		ory
j	General Engineering Science (German program, 7 semester): Specialisation Mechanical	5	5
		5 5,	
	Compulsory		
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	neering, Focus Th	neoretical Mechan
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory	neering, Focus Tł	heoretical Mechan
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	-	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory	-	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I	Engineering, Fo	cus Aircraft Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory	Engineering, Fo	cus Aircraft Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	Engineering, Foo neering, Focus M	cus Aircraft Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical f Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Compulsory	Engineering, Foo neering, Focus M	cus Aircraft Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical In Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical General Engineering Science (German program, 7 semester): Specialisation Mechanical General Engineering Science (German program, 7 semester): Specialisation Mechanical	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering,	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical I Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical In Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical In Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elect
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical E Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	Engineering, Foo neering, Focus M Engineering, Foo als: Compulsory al Engineering, Pry	cus Aircraft Syste lechatronics: Elec cus Energy Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Advanced Materia General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Sciences: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulso Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulso Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	Engineering, Foc neering, Focus M Engineering, Foc als: Compulsory al Engineering, my ory	cus Aircraft Syste lechatronics: Elect

ourse L0417: Numerical Mathematics I		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	EN	
Cycle	WiSe	
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss guadrature, adaptive guadrature 	
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 	

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

Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular comple	ke numbers, integrals, differentials		
Knowledge	Design of electrical engineering and machine			
	Basics of electrical engineering and mechan	ical engineering		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic	principles of electric and magnetic fields.		
	They can describe the function of the s	tandard types of electric machines and pres	ent the correspon	dina equations a
		es they can explain the major parameters of the		
	from the power grid to the driven engine.		energy enterener	
	, 5 5			
Skills		onal electric and magnetic fields in particular f	erromagnetic circu	uits with air gap. I
	this they apply the usual methods of the de	sign auf electric machines.		
	They can calulate the operational performa	nce of electric machines from their given char	acteristic data and	d selected quantit
	and characteristic curves. They apply the us	ual equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculat	e electric and magnatic fields for applications. T	hey are able to ar	nalyse independen
		chines from the charactersitic data and theyca	n calculate thereo	f selected quantit
	and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time in	Locture 70		
Credit points				
Course achievement				
	Subject theoretical and practical work			
	Design of four machines and actuators, revi	aw of design files		
scale	Design of four machines and actuators, revi	ew or design mes		
	General Engineering Science (German progr	am, 7 semester): Specialisation Electrical Engine	ering: Elective Co	mpulsory
Following Curricula		gram, 7 semester): Specialisation Lectrical Engine gram, 7 semester): Specialisation Mechanical	-	
j	Compulsory		5 - 5,	
	General Engineering Science (German p	ogram, 7 semester): Specialisation Mechanic	al Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (German prog	am, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechani
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualifi			
	Electrical Engineering: Core Qualification: El			
	Engineering Science: Specialisation Electrica	 Engineering: Elective Compulsory Specialisation Energy Technology: Elective Cor 	mulcony	
	Logistics and Mobility: Specialisation Engine	1 31 31	призогу	
		Planning and Systems: Elective Compulsory		
		tion Management and Processes: Elective Comp	ulsory	
	Mechanical Engineering: Core Qualification:		-	
	Mechatronics: Core Qualification: Compulso	У		
	Technomathematics: Specialisation III. Engin	neering Science: Elective Compulsory		
	Engineering and Management - Major in Log	istics and Mobility: Specialisation Traffic Plannin	g and Systems: Ele	ective Compulsory
	Engineering and Management - Major in L	ogistics and Mobility: Specialisation Production	Management and	Processes: Elect
	Compulsory			

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

Course L0294: Electrical Mac	Course L0294: Electrical Machines and Actuators	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thorsten Kern, Dennis Kähler	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L076	33)	Lecture	3	4
Semiconductor Circuit Design (L086		Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
-	Fundamentals of electrical engineering			
Knowledge				
	Basics of physics, especially semiconductor ph	nysics		
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge				
5		nality of different MOS devices in electronic cir		
		g circuits functions and where they are applied.		
		nality of fundamental operational amplifiers an		
	-	logic circuits and can discuss their advantages	-	s.
		ry circuits and can explain their functionality ar	d specifications.	
	 Students know the appropriate fields for 	r the use of bipolar transistors.		
Skills	 Students can calculate the specification 	ns of different MOS devices and can define the	parameters of elec	tronic circuits.
		ogic circuits and can design different types of l		
		onal amplifiers and bipolar transistors for speci		
Personal Competence				
Social Competence	- Chudente ere able werk officiently in be			
	 Students are able work efficiently in he Students working together in small gray 	ups can solve problems and answer professiona	l questions	
			ii questions.	
Autonomy				
, aconomy	 Students are able to assess their level of 	of knowledge.		
	Independent Study Time 124, Study Time in L	ecture 56		
Credit points Course achievement				
Examination				
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program	m, 7 semester): Specialisation Electrical Engine	ering: Compulsory	
Following Curricula	General Engineering Science (German pro-	gram, 7 semester): Specialisation Mechanic	al Engineering, F	ocus Mechatror
	Compulsory			
	Data Science: Core Qualification: Elective Con	npulsory		
	Electrical Engineering: Core Qualification: Con	npulsory		
	Engineering Science: Specialisation Electrical	Engineering: Compulsory		
	Engineering Science: Specialisation Mechatron	nics: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program	n, 7 semester): Specialisation Mechatronics: Co	npulsory	
	Computer Science in Engineering: Specialisati	on II. Mathematics & Engineering Science: Elec	tive Compulsory	
	Mechanical Engineering: Specialisation Mecha	tronics: Compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engine	ering Science: Elective Compulsory		

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

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

Module M0854: Mathe	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Differential Equations) (L1043)		Lecture	2	1
Differential Equations 2 (Partial Differential Equations) (L1044)		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof Anusch Taraz	· • ·		
Admission Requirements	None			
	Mathematics I - III			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge				
	 Students can name the basic concepts in 	Mathematics IV. They are able to explain the	em using appropri	ate examples.
	 Students can discuss logical connections 	between these concepts. They are capabl	e of illustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and can repro 	duce them.		
Skills	 Students can model problems in Mathem 	vatics IV with the help of the concepts stur	hind in this course	Moreover they a
				. Moreover, they a
	capable of solving them by applying estab			
	 Students are able to discover and verify full 	urther logical connections between the conc	epts studied in the	e course.
	 For a given problem, the students can c 	levelop and execute a suitable approach,	and are able to c	ritically evaluate t
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in tear 			
	 In doing so, they can communicate new c 	oncepts according to the needs of their coo	operating partners	. Moreover, they c
	design examples to check and deepen the	e understanding of their peers.		
Autonomy	 Students are capable of checking their up 	nderstanding of complex concepts on their	own. They can sp	ecify open questio
	precisely and know where to get help in so		own: mey can sp	celly open questio
		-		
	 Students have developed sufficient persi 	stence to be able to work for longer perio	ids in a goal-orien	ted manner on ha
	problems.			
	Independent Study Time 68, Study Time in Lectu	ire 112		
Credit points				
Course achievement Examination	None Written exam			
		ial Equations 2)		
	60 min (Complex Functions) + 60 min (Differenti	ai Equations 2)		
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Electrical Engine	eering: Compulsor	у
Following Curricula	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanic	cal Engineering,	Focus Mechatronio
-	Compulsory			
		7 competer), Charialization Nevel Andrita	Iroi Compulsor	
	General Engineering Science (German program,	•		
	General Engineering Science (German program,	7 semester): Specialisation Mechanical Eng	ineering, Focus Th	neoretical Mechanio
	Engineering: Elective Compulsory			
	Electrical Engineering: Core Qualification: Comp	ulsorv		
			oring: Compulse	
	General Engineering Science (English program, 7			
	Computer Science in Engineering: Specialisation		ctive Compulsory	
	Mechanical Engineering: Specialisation Mechatro	onics: Compulsory		
	Mechanical Engineering: Specialisation Theoretic	al Mechanical Engineering: Elective Compu	lsory	
		al Mechanical Engineering: Elective Compu	lsory	
	Mechatronics: Core Qualification: Compulsory		lsory	
)ry	-	

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

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

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

Course L1038: Complex Fund	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 Fund	ourse L1041: Complex Functions	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Courses							
Title					Tur	Line (with	СР
Computer Science for Engineers - F	Programming	Concents	Data Handling & Comm	unication (12689)	Typ Lecture	Hrs/wk 3	3
Computer Science for Engineers - F			-		Recitation Section (small)	2	3
Module Responsible	1						
Admission Requirements			-				
Recommended Previous	None						
Knowledge							
Educational Objectives	After takin	a part suc	cessfully, students hav	e reached the follo	ving learning results		
Professional Competence	Alter takin	g puit suc	cessiany, students na	ve reached the folio	wing learning results		
Knowledge							
Skills							
Skiis							
Personal Competence							
Social Competence							
Autonomy							
Workload in Hours	Independe	nt Study 1	Time 110, Study Time i	in Lecture 70			
Credit points	6						
Course achievement	Compulsory		Form	Description			
	No	10 %	Attestation	Testate fine	den semesterbegleitend statt.		
Examination	Written ex	am					
Examination duration and	120 min						
scale							
			g Science (German p	program, 7 semest	er): Specialisation Mechanica	al Engineering, F	ocus Biomechani
Following Curricula							
					Specialisation Biomedical Engir		
			Science (German prog	gram, 7 semester): S	Specialisation Green Technolog	jies, Focus Renew	able Energy: Elect
	Compulsor	-	a Science (Corman n	rogram 7 comosto	r): Specialisation Mechanical	Engineering For	us Eporav Syston
	Compulsor		g science (German p	lografii, 7 serifeste	i). Specialisation Mechanical	Engineering, Foc	us Ellergy System
		-	n Science (German n	rogram 7 semeste	r): Specialisation Mechanical	Engineering For	us Aircraft System
	Engineerin			logiani, i semeste		2.1.9.1.00	
				program, 7 semes	ter): Specialisation Mechanic	al Engineering,	Focus Mechatroni
	Compulsor	У					
	General Er	ngineering	Science (German pro	gram, 7 semester):	Specialisation Mechanical Eng	gineering, Focus F	Product Developme
	and Produc	ction: Elec	tive Compulsory				
	General Er	ngineering	Science (German prog	gram, 7 semester): 9	Specialisation Electrical Engine	ering: Elective Co	mpulsory
	General Er	ngineering	Science (German pro	gram, 7 semester):	Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechanio
	Engineerin	g: Elective	e Compulsory				
		-	ing: Core Qualification				
			ocess Engineering: Cor		pulsory		
			g: Core Qualification: (
		-			ergy Systems: Elective Compu	lsory	
	_		y: Specialisation Inform		Compulsory		
			Qualification: Compuls				
			: Core Qualification: Co				
	Engineerin	g and Mar	nagement - Major in Lo	distics and Mobility	Specialisation Information Tec	hnology. Compul	sorv

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

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

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.

Courses	
Title Advanced Mechanical Design Projec	t (L0266) Typ Hrs/wk CP Project-/problem-based Learning 4 6
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous Knowledge	 Mechanical Engineering: Design Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	After passing the module, students are able to: • express the procedure for systematically handling of
	 complex design tasks , describe working principles, their use and combination possibilities, explain guidelines for designing for function and manufacturing, explain advanced use-oriented knowledge of machine elements.
Skills	 After passing the module, students are able to: analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, use methods to design and solve engineering design tasks systematically and solution-oriented, create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail.
Personal Competence Social Competence	After passing the module, students are able to: present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course
Autonomy	 After passing the module, students are able to: independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selectir appropriate methods, to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory Bonus Form Description Yes None Attestation Image: Computer of the second s
Examination	Written exam
Examination duration and	180
scale Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systen Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
Content	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.
	Getriebekonstruktion in Einzelarbeit
	Erarbeitung von Lösungsprinzipien
	Berechnung von Maschinenelementen
	Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten
	Erstellung einer ausführlichen Dokumentation
	Lösungsfindung
	 Methodische Erarbeitung von prinzipiellen Lösungskonzepten
	Erstellen einer Dokumentation
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

Courses							
Title		Тур	Hrs/wk	СР			
Fundamentals of Machine Tools (LC		Lecture	2	2 1			
Fundamentals of Machine Tools (LI Forming and Cutting Technology (L		Recitation Section (large) Lecture	1 2	2			
Forming and Cutting Technology (L		Recitation Section (large)	1	1			
Module Responsible	Prof. Wolfgang Hintze						
Admission Requirements	None						
Recommended Previous	without major course assessment						
Knowledge							
	internship recommended						
	Previous knowledge in mathematics, mechani	cs and electrical engineering					
Educational Objectives	After taking part successfully, students have r	eached the following learning results					
Professional Competence							
Knowledge	Students are able to						
	explain the basics of chip formation and			-1-			
		sign and analysis of metal forming, machining					
		ool building and give an overview on trends in		-			
		ons of CNC-machines and give an overview on	multi-machine sys	stems.			
	 explain equipment components. 						
Skills	Students are able to						
	 select tool geometry, cutting materials 	process parameters and appropriate measu	rina technique in	accordance with t			
	 select tool geometry, cutting materials, process parameters and appropriate measuring technique in accordance with th requirements. 						
	 estimate occurring forces and temperatures during chip formation. 						
			nd milling.				
	 select appropriate machine tools for machining and create NC programs for turning and milling. assess the quality of a machine tools and to detect weak points. 						
Personal Competence							
Social Competence	Students are able to						
	 develop solutions in a production enviro 	onment with qualified personnel at technical le	vel and represent	decisions.			
Autonomy	Students are able to						
	 interpret independently cutting process 	es.					
	create independently NC programs.						
	select independently machine tools by reference to appropriate requirements.						
	assess own strengths and weaknesses in general.						
	 assess their learning progress and defined 	e gaps to be improved.					
	 assess possible consequences of their a 	ctions.					
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84					
Credit points							
Course achievement	None						
Examination	Written exam						
Examination duration and	180 min						
scale							
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical En	gineering, Focus I	Product Developme			
	and Production: Compulsory		-	-			
-	Mechanical Engineering: Specialisation Produc	t Development and Production: Compulsory					
	Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory						

Course L0689: Fundamentals	
Typ Hrs/wk	Lecture
CP	
	Independent Study Time 32, Study Time in Lecture 28
	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-machine systems
	Equipmentcomponents for machine tools
	Assessment of machine tools
Literature	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
	ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Wack Manfrad Brachar Christian
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006

Course L1992: Fundamentals	ourse L1992: Fundamentals of Machine Tools		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0613: Forming and	Cutting Technology			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	ependent 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	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 M0725: Produ	ction Engineering					
Courses						
Title		Тур	Hrs/wk	СР		
Production Engineering I (L0608)		Lecture	2	2		
Production Engineering I (L0612)		Recitation Section (large)	1	1		
Production Engineering II (L0610)		Lecture	2	2		
Production Engineering II (L0611)		Recitation Section (large)	1	1		
Module Responsible	Prof. Wolfgang Hintze					
-	None					
-						
	no course assessments required					
Knowledge	internship recommended					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results				
Professional Competence						
Knowledge	Students are able to					
	- nome basis stitutis for the coloction					
	name basic criteria for the selection					
	 name the main groups of Manufact 					
	 name the application areas of diffe 					
		disadvantages of the different manufacturing proce				
	 describe elements, geometric prop 	erties and kinematic variables and requirements fo	r tools, workpiece	and process.		
	 explain the essential models of ma 	nufacturing technology.				
Skills	Students are able to					
	select manufacturing processes in accordance with the requirements.					
		r simple tasks to meet the required tolerances of th	ie component to t	be produced.		
	 assess components in terms of the 	ir production-oriented construction.				
Personal Competence						
Social Competence	Students are able to					
	 develop solutions in a production e 	nvironment with qualified personnel at technical le	vel and represent	decisions.		
Autonomy	Students are able to					
	 interpret independently the manufa 					
	 assess own strengths and weaknesses in general. 					
	 assess their learning progress and 					
	 assess possible consequences of the 	eir actions.				
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84				
Credit points	6					
Course achievement						
Examination	Written exam					
Examination duration and	120 min					
scale	120 1111					
	Conoral Engineering Science (Corman pr	ogram, 7 semester): Specialisation Mechanical Eng	ninooring Focus	Product Dovolopr		
-		ogram, 7 semester). Specialisation Mechanical Eng	gineering, rocus r	Toduce Developi		
Following Curricula	and Production: Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic					
	Engineering: Elective Compulsory					
	Digital Mechanical Engineering: Core Qualification: Compulsory					
	Engineering Science: Specialisation Mecha	anical Engineering: Compulsory				
	General Engineering Science (English prog	gram, 7 semester): Specialisation Mechanical Engin	eering: Compulso	ry		
	Green Technologies: Energy, Water, Clima	ate: Specialisation Energy Technology: Elective Con	npulsory			
	Logistics and Mobility: Specialisation Prod	uction Management and Processes: Compulsory				
	Logistics and Mobility: Specialisation Engi	neering Science: Elective Compulsory				
	Mechanical Engineering: Core Qualificatio	n: Compulsory				
	Mechatronics: Core Qualification: Compute	sory				

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

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

Course L0610: Production En	igineering II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	 Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.] : Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007

Course L0611: Production En	igineering II
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses						
ītle		Тур	Hrs/wk	СР		
Companion Lecture for Materials So	ience Laboratory (L1088)	Lecture	2	2		
Material Science Laboratory (L1235	-	Practical Course	4	4		
Module Responsible	Prof. Kaline Pagnan Furlan					
Admission Requirements	None					
Recommended Previous	none					
Knowledge						
Educational Objectives	After taking part successfully, students have	ve reached the following learning results				
Professional Competence						
Knowledge	Students are able to give a summary of	the technical details of experiments in the	area of materials so	iences and illust		
	respective relationships. They are capable	e of describing and communicating relevant	problems and question	ns using appropr		
	technical language. They can explain the t	sypical process of solving practical problems a	nd present related res	ults.		
Skille	The students can transfer their fundamen	ntal knowledge on material sciences to the p	record of colving prod	tical problems. T		
JKIIIS		uring the realization of experiments in the cont		- · ·		
	identify and overcome typical problems de					
Personal Competence						
Social Competence	Students are able to cooperate in small gr	oups in order to conduct experiments in the co	ontext of materials sc	iences. They are a		
	to effectively present and explain their res	ults alone or in groups in front of a qualified a	udience.			
Autonomy	Students are capable of solving problems	in the context of materials sciences using pr	ovided literature. The	y are able to fill g		
,		the literature and other sources provided by t		5		
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84				
Credit points	6					
Course achievement	None					
Examination	Subject theoretical and practical work					
Examination duration and	Test reports on the respective tests and or	nline learning modules with integrated success	control			
scale						
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanica	Engineering, Focus I	Product Developm		
Following Curricula	and Production: Elective Compulsory					
	General Engineering Science (German prog	gram, 7 semester): Specialisation Advanced M	aterials: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mec	hanical Engineering,	Focus Materials		
	Engineering Sciences: Compulsory					
	Engineering Science: Specialisation Advan	ced Materials: Compulsory				
	Mechanical Engineering: Specialisation Pro	duct Development and Production: Compulsor	У			
	Mechanical Engineering: Specialisation Ma	terials in Engineering Sciences: Compulsory				
	Product Development, Materials and Produ	iction: Technical Complementary Course Core	Studies: Elective Com	nulsory		

Course L1088: Companion Le	ecture for Materials Science Laboratory
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kaline Pagnan Furlan
Language	DE/EN
Cycle	WiSe
Content	- Introduction to the Materials Science Laboratory practical course and learning modules;
	- Collection of data: source of errors and sample distribution;
	- Error calculation;
	- Report writing and presentation of results;
	- Graph plotting using software(s).
Literature	1) W.D. Callister, Materials science and engineering: an introduction, Wiley 2000 https://katalog.tub.tuhh.de/Record/270018409 or
	https://katalog.tub.tuhh.de/Record/1696922097 (online link at 'Exemplare')
	2) John R. Taylor, Fehleranalyse: eine Einführung in die Untersuchung von Unsicherheiten in physikalischen Messungen, 1. Aufl.,
	VCH Verlag, 1988 https://katalog.tub.tuhh.de/Record/027422038 // An Introduction to Error Analysis: The Study of Uncertainties
	in Physical Measurements, 2d Edition, University Science Books, 1997 https://katalog.tub.tuhh.de/Record/024511676
	in mysical ricesarchients, za zakon, oniverský science books, 1997 https://katalog.tab.talni.de/kecolu/024511070

	nce Laboratory
Тур	Practical Course
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
	Prof. Kaline Pagnan Furlan, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Bodo Fiedler, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE/EN
Cycle	WiSe
Content	5 laboratory experiments:
	- Metals: Tensile test
	- Plastics: Scanning electron microscopy on fracture surfaces of fiber reinforced plastics
	- Plastics: Bending test - bending properties of carbon fiber reinforced plastics
	- Ceramics: Ceramic synthesis - From raw material up to sintered product
	- Ceramics: Mechanical testing - hardness and fracture toughness of ceramic materials
Literature	1) Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II
	2) W.D. Callister, Materials science and engineering: an introduction, Wiley 2000 https://katalog.tub.tuhh.de/Record/270018409 or https://katalog.tub.tuhh.de/Record/1696922097 (online link at 'Exemplare')

Module M0599: Integ	rated Product D	evelopment and	l Lightweigh	t Design		
Courses						
Title CAE-Team Project (L0271) Development of Lightweight Design	n Products (L0270)			Typ Project-/problem-based Learning Lecture	Hrs/wk 2 2	CP 2 2
Integrated Product Development I				Lecture	2	2
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous	Advanced Knowledge a	bout engineering desig	n:			
Knowledge	Fundamentals of Mecha	anical Engineering Desi	gn			
	Mechanical Engineering	g: Design				
	Advanced Mechanical E	Engineering Design				
Educational Objectives	After taking part succe	ssfully, students have r	eached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the m	odule, students are cap	bable of:			
		Inctional principle of 3D		0M- and FEM-Systems the product development proces		
	 describing the in 		nt CAE-Systems in	the product development proces	55	
Skills						
	After completing the m	odule, students are abl	e to:			
	1 5					
	 evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification scheme product structuring design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload 				cation schemes and	
Personal Competence						
	After completing the m	odule, students are abl	e to:			
		pject plan and allocate v results as a team for ins		vork packages in the framework ation	of group discu	issions
Autonomy	Students are capable o	f:				
	 independently a 	dapt to a CAE-Tool and	complete a given	practical task with it		
Workload in Hours	Independent Study Tim	e 96, Study Time in Le	cture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 20 %	practical work	andCAE-Teampro	ojekt inkl. Vortrag und Ausarbeit	ung	
Examination	Written exam					
Examination duration and						
scale						
Assignment for the	General Engineering S	Science (German prog	ram, 7 semester)	: Specialisation Mechanical Eng	gineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulso	ry				
			m, 7 semester): S	pecialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compu	-				
	Engineering Science: S					
				ecialisation Mechanical Engineeri d Production: Compulsory	iig: Elective Co	unpulsory
	Mechanical Engineering					
				plementary Course Core Studies:	Elective Com	oulsory

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

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

Course L0269: Integrated Pr	oduct Development 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

Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L	0925)	Lecture	2	3
Quality Management (L0926)		Lecture	2	3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the conten	ts of the lecture of the module.		
Skills	Students are able to apply the methods	and models in the module to industrial problem	IS.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mecha	nical Engineering, Foc	us Aircraft Syster
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mechanica	al Engineering, Focus P	Product Developme
	and Production: Compulsory			
	General Engineering Science (German p	rogram, 7 semester): Specialisation Advanced N	Materials: Elective Com	pulsory
	Engineering Science: Core Qualification	Compulsory		
	Engineering Science: Specialisation Med	hatronics: Elective Compulsory		
	Engineering Science: Specialisation Med	hanical Engineering: Elective Compulsory		
	Engineering Science: Specialisation Adv	anced Materials: Elective Compulsory		
	Logistics and Mobility: Specialisation Pro	oduction Management and Processes: Compulso	ry	
	Logistics and Mobility: Specialisation En		-	
	Mechanical Engineering: Core Qualificat			
		Logistics and Mobility: Specialisation Production	n Managomont and Pro	cassas: Compulso

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

Courses						
Title				Tum	Hrs/wk	CP
Computer Science for Engineers - F	Programming Concepts, Data Ha	andling & Communication ((12689)	Typ Lecture	3	3
Computer Science for Engineers - F		-		Recitation Section (small)	2	3
Module Responsible		-				
Admission Requirements	-					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part successful	v. students have reache	d the followi	ng learning results		
Professional Competence	······ ·······························	,,				
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Time 11	0, Study Time in Lecture	e 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description	and the second second second second second		
		station 1	l estate finde	en semesterbegleitend statt.		
Examination	Written exam					
Examination duration and	120 min					
scale	Concerl Frazina ania a Caisa		7	a) Canadaliantina Manhanina	L Facilitation - F	Diana diana diana di
Following Curricula		ice (German program,	/ semester	r): Specialisation Mechanica	ii Engineering, r	ocus Biomechanic
Following curricula	Compulsory	e (German program 7 se	omostor): Sn	ecialisation Biomedical Engin	eering: Compuls	Nrv
				ecialisation Green Technolog		
	Compulsory	e (eerman program) / ee	emester, op		ies, i ocus iterien	able Energy: Elect
		ce (German program, 7	7 semester):	Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory				5 5.	5, ,
	General Engineering Scien	ce (German program, 7	7 semester)	: Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Compulsory					
	General Engineering Scier	ice (German program,	7 semeste	r): Specialisation Mechanica	al Engineering, I	Focus Mechatroni
	Compulsory					
	General Engineering Science	e (German program, 7 s	semester): S	pecialisation Mechanical Eng	ineering, Focus F	roduct Developme
	and Production: Elective Co	mpulsory				
				ecialisation Electrical Engine		
			emester): Sp	pecialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Elective Comp	-				
	Bioprocess Engineering: Col		-	ulcon		
	Chemical and Bioprocess Er Electrical Engineering: Core			uisoi y		
				rgy Systems: Elective Compul	lsory	
	Logistics and Mobility: Spec				isor y	
	Mechatronics: Core Qualifica		ciniology. Ct	mpuisory		
	Process Engineering: Core Q		4			
				Specialisation Information Tec	hnology: Comput	sorv
	and manageme					

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

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

Focus Theoretical Mechanical Engineering

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

Courses					
Title		Тур	Hrs/wk	СР	
Numerical Mathematics I (L0417)		Lecture	2	3	
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3	
Module Responsible	Prof. Sabine Le Borne				
Admission Requirements					
Recommended Previous					
Knowledge	 Mathematik I + II for Engineering Students (get 	rman or english) or Analysis & Linear Ale	gebra I + II for Te	chnomathematici	
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	Students are able to				
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root findi problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 				
Skills	Students are able to				
	 implement, apply and compare numerical meth justify the convergence behaviour of numerical select and execute a suitable solution approach 	methods with respect to the problem a	nd solution algor	ithm,	
Personal Competence					
Social Competence	Students are able to				
	 work together in heterogeneously composed to explain theoretical foundations and support ea 				
Autonomy	Students are capable				
	 to assess whether the supporting theoretical an to assess their individual progess and, if necess 		l individually or ir	n a team,	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale					
	General Engineering Science (German program, 7 ser	nester): Specialisation Computer Scienc	e. Compulsory		
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 Engineering: Elective Compulsory General Engineering Science (German program, 7 set Compulsory General Engineering Science (German program, 7 Elective Compulsory General Engineering Science (German program, 7 Elective Compulsory General Engineering Science (German program, 7 Engineering Science (German program, 7 Engineering Science (German program, 7 Engineering Science: Compulsory Bioprocess Engineering: Specialisation A - General Bio Computer Science: Specialisation II. Mathematics and Data Science: Core Qualification: Compulsory	mester): Specialisation Mechanical Engin semester): Specialisation Mechanical mester): Specialisation Mechanical Engi semester): Specialisation Mechanical mester): Specialisation Advanced Materia 7 semester): Specialisation Mechanical pprocess Engineering: Elective Compulso Engineering Science: Elective Compulso	neering, Focus Th Engineering, Foc neering, Focus M Engineering, Foc als: Compulsory cal Engineering, pry	neoretical Mechani cus Aircraft Syste echatronics: Elect us Energy Syster	
	Electrical Engineering: Core Qualification: Elective Con Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Machanical Engineering: Engineering: Core Qualification:				
	Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Mechanical Engineering: Specialisation Theoretical Me	echanical Engineering: Compulsory			
	Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification:	echanical Engineering: Compulsory ns: Elective Compulsory	Compulsory		

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sabine Le Borne
Language	EN
Cycle	WiSe
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer

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

Module M0684: Heat	Transfer				
Courses					
Title	Тур)	Hrs/wk	СР	
Heat Transfer (L0458)	Lect	ture	3	4	
Heat Transfer (L0459)	Reci	itation 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 le	arning results			
Professional Competence					
Knowledge	The students can				
	- explain the technical terms,				
	- classify the various physical processes of heat transfer in terms of c	onduction-based and radiat	ion-based mech	anisms,	
	- simplify and critically analyze complex heat transfer processes using	g models,			
	- methodically develop solutions to tasks.				
Skills	The students are able to				
	- describe the physics of the different Heat Transfer mechanism,				
	- simplifywith models, calculate and evaluate complex Heat Transfer	processes,			
	- critically question and answer statements on heat transfer,				
	- solve excersises self-consistent and in small groups.				
Personal Competence Social Competence	In lectures and exercises, the students can use many examples an manner, develop a solution and present it. Within the exercises, th work out targeted solutions.				
Autonomy	The students can check their level of knowledge by means of repetition discuss answers in exchange with the other students. In the exercises the lectures in complex tasks and critically analyze the results in the	s, the students work in sma			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale			da se sulta se tra		
Assignment for the	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Eng	ineering, Focus	Energy System	
Following Curricula		isation Biomodical Engineer	ing: Compulser	1	
	General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special	5	5 1 3		
	Engineering: Compulsory	isation mechanical Enginee	inig, rocus rife		
	Energy Systems: Technical Complementary Course Core Studies: Elec	ctive Compulsory			
	Integrated Building Technology: Core Qualification: Compulsory				
	Mechanical Engineering: Specialisation Energy Systems: Compulsory				
	Mechanical Engineering: Specialisation Theoretical Mechanical Engine				

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, Heat Conduction (steady and unsteady) , Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course L0459: Heat Transfer	urse L0459: Heat Transfer		
Тур	Recitation Section (large)		
Hrs/wk	2		
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 M0725: Produ	iction Engineering			
Courses				
litle .		Тур	Hrs/wk	СР
Production Engineering I (L0608)		Lecture	2	2
Production Engineering I (L0612)		Recitation Section (large)	1	1
Production Engineering II (L0610)		Lecture	2	2
Production Engineering II (L0611)		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous				
	no course assessments required			
Knowledge	internship recommended			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
	 name basic criteria for the selection of 	manufacturing processos		
	name basic criteria for the selection of			
	name the main groups of Manufacturin			
	 name the application areas of different 			
		advantages of the different manufacturing proc		
	÷	es and kinematic variables and requirements for	r tools, workpiece	and process.
	 explain the essential models of manufa 	acturing technology.		
Skills	Students are able to			
	 soloct manufacturing processes in according 	ordance with the requirements		
	 select manufacturing processes in accordance with the requirements. design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced. 			
			ie component to t	se produced.
	 assess components in terms of their pr 	oduction-oriented construction.		
Personal Competence				
Social Competence	Students are able to			
	 develop colutions in a production onvir 	anmont with qualified personnal at technical la	val and represent	docicione
	develop solutions in a production envir	onment with qualified personnel at technical le	ver and represent	decisions.
Autonomy	Students are able to			
	 interpret independently the manufacture 	ring process		
	 assess own strengths and weaknesses 			
	 assess their learning progress and def 			
	assess possible consequences of their	actions.		
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement				
Examination				
Examination duration and				
	120 1111			
scale				
-		am, 7 semester): Specialisation Mechanical Eng	gineering, Focus F	Product Developm
Following Curricula	and Production: Compulsory			
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	neoretical Mechar
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualifica	ation: Compulsory		
	Engineering Science: Specialisation Mechanic	al Engineering: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical Engir	eering: Compulso	ory
		Specialisation Energy Technology: Elective Cor		
	Logistics and Mobility: Specialisation Producti			
	Logistics and Mobility: Specialisation Froduction			
	Mechanical Engineering: Core Qualification: C			
	Mechatronics: Core Qualification: Compulsory			
	Engineering and Management - Major in Logis	tics and Mobility: Specialisation Production Mai	nagement and Pro	cesses: compuls

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

Course L0612: Production En	ourse L0612: Production Engineering I				
Тур	citation Section (large)				
Hrs/wk					
CP					
Workload in Hours	pendent Study Time 16, Study Time in Lecture 14				
Lecturer	Wolfgang Hintze				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Course L0610: Production Er	igineering II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	 Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.] : Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007

Course L0611: Production En	ourse L0611: Production Engineering II				
Тур	Recitation Section (large)				
Hrs/wk					
CP					
Workload in Hours	ndent Study Time 16, Study Time in Lecture 14				
Lecturer	Wolfgang Hintze, Prof. Claus Emmelmann				
Language					
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Courses					
Title		Тур	Hrs/wk	СР	
Electrical Machines and Actuators (L0293)	Lecture	3	4	
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2	
Module Responsible	Prof. Thorsten Kern				
Admission Requirements	None				
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals, differentials				
Knowledge	Design of electrical engineering and machanical engineering				
	Basics of electrical engineering and mecha	anical engineering			
Educational Objectives	After taking part successfully, students have	ve reached the following learning results			
Professional Competence					
Knowledge	Students can to draw and explain the basic	c principles of electric and magnetic fields.			
	They can describe the function of the	standard types of electric machines and pres	sent the correspor	dina equations a	
		ives they can explain the major parameters of the			
	from the power grid to the driven engine.		e energy emelency		
Skills		sional electric and magnetic fields in particular 1	ferromagnetic circu	uits with air gap. I	
	this they apply the usual methods of the de	esign auf electric machines.			
	They can calulate the operational perform	nance of electric machines from their given char	racteristic data and	d selected quantit	
	and characteristic curves. They apply the usual equivalent circuits and graphical methods.				
Personal Competence					
Social Competence	none				
Autonomy	Students are able independently to calcula	ate electric and magnatic fields for applications.	They are able to ar	nalyse independer	
		nachines from the charactersitic data and theyca	an calculate thereo	f selected quantit	
	and characteristic curves.				
Workload in Hours	Independent Study Time 110, Study Time i	in Locture 70			
Credit points					
Course achievement					
	Subject theoretical and practical work				
		view of decign files			
scale	Design of four machines and actuators, rev	view of design mes			
	General Engineering Science (German proc	gram, 7 semester): Specialisation Electrical Engin	ooring: Elective Co	mulson	
Following Curricula		rogram, 7 semester): Specialisation Electrical Engin	-		
· · · · · · · · · · · · · · · · · · ·	Compulsory		,,,		
	General Engineering Science (German)	program, 7 semester): Specialisation Mechani	cal Engineering, I	Focus Mechatroni	
	Compulsory				
	General Engineering Science (German prog	gram, 7 semester): Specialisation Mechanical Eng	gineering, Focus Th	neoretical Mechani	
	Engineering: Elective Compulsory				
	Digital Mechanical Engineering: Core Quali				
	Electrical Engineering: Core Qualification: E				
	Engineering Science: Specialisation Electric				
	Green Technologies: Energy, Water, Climat Logistics and Mobility: Specialisation Engin	te: Specialisation Energy Technology: Elective Co peering Science: Elective Compulsory	mpulsory		
		c Planning and Systems: Elective Compulsory			
		uction Management and Processes: Elective Comp	oulsory		
	Mechanical Engineering: Core Qualification				
	Mechatronics: Core Qualification: Compulse				
	Technomathematics: Specialisation III. Eng				
	Engineering and Management - Major in Lo	ogistics and Mobility: Specialisation Traffic Plannin	ig and Systems: Ele	ective Compulsory	
	Engineering and Management Major in	Lesistics and Mahiller. Consideration Develoption			
	Compulsory	Logistics and Mobility: Specialisation Production	Management and	Processes: Elect	

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

Course L0294: Electrical Machines and Actuators				
Тур	Recitation Section (large)			
Hrs/wk				
CP	2			
Workload in Hours	ndent Study Time 32, Study Time in Lecture 28			
Lecturer	Thorsten Kern, Dennis Kähler			
Language				
Cycle	SoSe			
Content	ee interlocking course			
Literature	See interlocking course			

Courses					
Title		Тур	Hrs/wk	СР	
Modeling, Simulation and Optimizat	ion (EN) (L2446)	Integrated Lecture	4	6	
Module Responsible	Prof. Benedikt Kriegesmann				
Admission Requirements	None				
Recommended Previous	Sound knowledge of engineering mathe	matics, engineering mechanics and fluid mechanic	S		
Knowledge					
Educational Objectives	After taking part successfully, students	have reached the following learning results			
Professional Competence					
Knowledge	Students will have an overview of varie	ous technical problems and the differential equation	ons, which describe	them. Students	
	gave an overview of different solution approaches and for which kind of problems they can be used for.				
Skille	Students are able to solve different tech	nnical problems with the introduced discretization r	nothods		
SKIIIS	Students are able to solve different tech	inical problems with the introduced discretization i	nethous.		
Personal Competence					
Social Competence	The students are able to discuss problem	ms and jointly develop solution strategies.			
Autonomi	The students are able to develop solution strategies for complex problems self-consistent and critically analyse results.				
Autonomy	The students are able to develop solution	on strategies for complex problems self-consistent	and critically analyse	e results.	
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	30 min				
scale					
Assignment for the	General Engineering Science (German p	program, 7 semester): Specialisation Mechanical E	ngineering, Focus Th	eoretical Mechan	
Following Curricula	Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory				
	General Engineering Science (German	program, 7 semester): Specialisation Mechanic	al Engineering, Foc	us Aircraft Syste	
	Engineering: Elective Compulsory				
	Engineering Science: Core Qualification:				
		Theoretical Mechanical Engineering: Compulsory Engineering Science: Elective Compulsory			

Course L2446: Modeling, Simulation and Optimization (EN)				
Тур	ntegrated Lecture			
Hrs/wk				
CP	; ;			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Lecturer	rof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried			
Language	N			
Cycle	oSe			
Content	 Partial Differential Equations in technical problems Overview of modelling approaches Finite Approximation Methods - Finite Differences / Elements / Volumes Introduction to the Discrete Element Method Numerical methods for time dependent problems Gradient-based optimization 			
Literature	Michael Schäfer, Computational Engineering - Introduction to Numerical Methods, Springer.			

Courses							
Title			Тур	Hrs/wk	СР		
Machine Learning I (L2432)			Lecture	2	3		
Machine Learning I (L2433)			Recitation Section (small)	2	3		
Module Responsible	Prof. Nihat Ay						
Admission Requirements	None						
Recommended Previous	Linear Algebra, Analy	sis, Basic Programming (Course				
Knowledge							
Educational Objectives	After taking part succ	essfully, students have r	eached the following learning results				
Professional Competence							
Knowledge	The students know						
	general princi	oles of machine learn	ing learning: supervised/unsupervised le	arning, generative/	descriptive learnin		
		-parametric learning	····g······g······g······				
			orks, support vector machines, clustering, o	limensionality reduc	tion. kernel method		
		f statistical learning the		,			
			r learning, reinforcement learning, genera	tive adversarial ne	tworks and adaptiv		
	control						
Skills	The students can						
	apply machine	learning methods to con	crete problems				
		uate suitable methods fo					
	 evaluate the q 	ality of a trained data-d	riven model				
	work with known software frameworks for machine learning						
	 adapt the arch 	 adapt the architecture and cost function of neural networks to specific problems show the limits of machine learning methods 					
	 show the limits 						
Personal Competence							
	Students can work or	complex problems both	independently and in teams. They can exch	ange ideas with ear	h other and use the		
Social competence	Students can work on complex problems both independently and in teams. They can exchange ideas with each other and use th individual strengths to solve the problem.						
	individual screngeris e	solve the problem.					
Autonomy	Students are able to	ndependently investigate	e a complex problem and assess which com	petencies are requir	ed to solve it.		
Workload in Hours	Independent Study T	me 124, Study Time in L	ecture 56				
Credit points							
Course achievement	Compulsory Bonus	Form	Description				
	No 20 %	Excercises					
Examination	Written exam						
Examination duration and	90 min						
scale							
Assignment for the	General Engineering	cience (German progra	m, 7 semester): Specialisation Mechanical E	ngineering, Focus T	heoretical Mechanic		
Following Curricula	Engineering: Elective	Compulsory					
	Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory						
		alification: Compulsory					
	Engineering Science:	Specialisation Advanced	Materials: Elective Compulsory				
	Engineering Science:	Specialisation Mechanica	al Engineering: Elective Compulsory				
	Engineering Science:	Specialisation Mechatror	nics: Elective Compulsory				
	Logistics and Mobility	Specialisation Informat	on Technology: Elective Compulsory				
	-		tical Mechanical Engineering: Elective Com	oulsory			
	Technomathematics:	Specialisation II. Informa	tics: Elective Compulsory				
	Engineering and Man	gement - Major in Logis	tics and Mobility: Specialisation Information	Technology: Elective	Compulsory		

Тур	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Nihat Ay
Language	
Cycle	SoSe
Content	 History of neuroscience and machine learning (in particular, the age of deep learning) McCulloch-Pitts neurons and binary Artificial Neural Networks Boolean and threshold functions Universality of McCulloch-Pitts neural networks Learning and the perceptron convergence theorem Support vector machines Harmonic analysis of Boolean functions Continuous Artificial Neural Networks Kolmogorov's superposition theorem Universal approximation with continuous neural networks Approximation error and the gradient decent method: the general idea The stochastic gradient decent method (Robbins-Monro and Kiefer-Wolfowitz cases)
Literature	Multilayer networks and the backpropagation algorithm Statistical Learning Theory Martin Anthony and Peter L. Bartlett. Neural Network Learning: Theoretical Foundations. Cambridge University Press, 1999 Martin Anthony. Discrete Mathematics of Neural Networks: Selected Topics. SIAM Monographs on Discrete Mathematics
	 Applications, 1987. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar. Foundations of Machine Learning, Second Edition. MIT Pres 2018. Christopher M. Bishop. Pattern Recognition and Machine Learning. Information Science and Statistics. Springer-Verlag, 200 Bernhard Schölkopf, Alexander Smola. Learning with Kernels: Support Vector Machines, Regularization, Optimization, a Beyond. Adaptive Computation and Machine Learning series. MIT Press, Cambridge, MA, 2002. Luc Devroye, László Györfi, Gábor Lugosi. A Probabilistic Theory of Pattern Recognition. Springer, 1996. Vladimir Vapnik. The Nature of Statistical Learning Theory. Springer-Verlag: New York, Berlin, Heidelberg, 1995.

Course L2433: Machine Learning I	
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Nihat Ay
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses						
Title				Тур	Hrs/wk	СР
Computer Science for Engineers - F	Programming Concepts, D	ata Handling & Communication	(L2689)	Lecture	3	3
Computer Science for Engineers - F	Programming Concepts, D	ata Handling & Communication	(L2690)	Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part succ	essfully, students have reache	ed the follow	ing learning results		
Professional Competence						
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours		me 110, Study Time in Lectur	e 70			
Credit points	6	_				
Course achievement	Compulsory Bonus		Description	en semesterbegleitend statt.		
Examination	Written exam	Attestation	restate fina	en semesterbegienend statt.		
Examination Examination duration and						
Examination duration and scale	120 min					
	Conoral Engineering	Science (Cormon program	7 comocto	r), Enocialization Machanica	Engineering	acus Piemechani
Assignment for the Following Curricula		Science (German program,	7 Semeste	r): Specialisation Mechanica	i Engineering, r	ocus biomechani
Tonowing curricula		Science (German program 7 s	emester). Sr	pecialisation Biomedical Engin	eerina: Compulso)rv
				pecialisation Green Technologi		
	Compulsory	······· [···]···				
		Science (German program,	7 semester)	: Specialisation Mechanical I	Engineering, Foc	us Energy Systen
	Compulsory					
	General Engineering	Science (German program,	7 semester)	: Specialisation Mechanical	Engineering, Foc	us Aircraft System
	Engineering: Compuls	ory				
	General Engineering	Science (German program,	7 semeste	er): Specialisation Mechanica	I Engineering, I	ocus Mechatroni
	Compulsory					
	General Engineering	Science (German program, 7	semester): S	Specialisation Mechanical Eng	ineering, Focus P	roduct Developme
	and Production: Electi	ve Compulsory				
				pecialisation Electrical Enginee		
			semester): S	pecialisation Mechanical Engir	neering, Focus Th	eoretical Mechani
	Engineering: Elective					
		ig: Core Qualification: Compul	-			
		ess Engineering: Core Qualific		uisory		
		: Core Qualification: Compulse		ray Systems: Elective Commu	50D/	
	-	: Specialisation Information Te		rgy Systems: Elective Compul	SULY	
		alification: Compulsory	crinology: C	ompulsory		
		Core Qualification: Compulsory	V			
			-	Specialisation Information Tec	haology: Comerci	50D/
	Engineering and Malla	agement - major in Logistics d	na mobility.	specialisation mormation rec	mology. comput	301 y

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

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

Module M0854: Mathe	ematics IV			
Courses				
		_		
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	erential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff	erential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	erential 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
		Rectation Section (large)	1	1
Module Responsible				
•	None			
Recommended Previous Knowledge	Mathematics I - III			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	• Students can name the basic concepts in M	athematics IV. They are able to explain the	m using appropri	ate examples.
	Students can discuss logical connections be	erween mese concepts. They are capable	or mustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and can reprodu 	uce them.		
	- · ·			
Skills				
	 Students can model problems in Mathema 	tics IV with the help of the concepts studie	ed in this course	. Moreover, they a
	capable of solving them by applying establi	shed methods.		
	 Students are able to discover and verify fur 	ther logical connections between the conce	pts studied in the	e course.
	• For a given problem, the students can de			
	- ·	velop allo execute a suitable approach, a		fillent evaluate
	results.			
Demonstration of the second				
Personal Competence				
Social Competence		-		
	 Students are able to work together in teams 			
	 In doing so, they can communicate new correction 	ncepts according to the needs of their coop	erating partners	. Moreover, they o
	design examples to check and deepen the u	understanding of their peers.		
	5	5		
Autonomy				
-	 Students are capable of checking their und 	lerstanding of complex concepts on their o	wn. They can sp	ecify open question
	precisely and know where to get help in sol	ving them.		
	 Students have developed sufficient persist 	ence to be able to work for longer period	s in a goal-orien	ted manner on h
		tenee to be uble to work for longer period	s in a goar orien	
	problems.			
	Independent Study Time 68, Study Time in Lecture	e 112		
Credit points Course achievement				
Examination				
		Equations 2)		
	60 min (Complex Functions) + 60 min (Differential	Equations 2)		
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Engine	ering: Compulsor	y
Following Curricula				-
. Showing curricula		., , semester, specialisation mechanica	. Engineering,	. seas meenau on
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engin	neering, Focus Th	neoretical Mechani
	Engineering: Elective Compulsory		3,	
	Electrical Engineering: Core Qualification: Compute	sory		
	General Engineering Science (English program, 7 s	semester): Specialisation Electrical Engineer	ring: Compulsory	
	Computer Science in Engineering: Specialisation II			
			compaisory	
	Mechanical Engineering: Specialisation Mechatron	ics: Compulsory		
	Mechanical Engineering: Specialisation Theoretica	I Mechanical Engineering: Elective Compuls	ory	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	4		
	Theoretical Mechanical Engineering: Technical Cor		~ ·	

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

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

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

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

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

Courses				
Title	2001	Typ Lecture	Hrs/wk	CP 2
Fundamentals of Materials Science Fundamentals of Materials Science	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. Ti for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws	cally the issues of atom he students know abou aracterizing specific p	nic structure, microstructor at the key aspects of char	ure, phase diagram racterization metho
Skills	The students are able to trace materials phenomena back the phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidification between processing conditions and the materials microstructed material's behavior.	ngth, ductility, and sti	ffness, chemical properti elting. The students can	es such as corrosi explain the relati
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours				
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	180 min			
scale				
-	General Engineering Science (German program, 7 semester): S			
Following Curricula	General Engineering Science (German program, 7 semester): S			ory
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S		d Materials: Compulsory	
	Data Science: Specialisation II. Application: Elective Compulsor			
	Digital Mechanical Engineering: Core Qualification: Compulsory			
	Green Technologies: Energy, Water, Climate: Specialisation Energy		ive compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elect			
		and Dreeses - Election		
	Logistics and Mobility: Specialisation Production Management a	and Processes: Elective	Compulsory	
	Logistics and Mobility: Specialisation Production Management a Mechanical Engineering: Core Qualification: Compulsory	and Processes: Elective	Compulsory	
	Logistics and Mobility: Specialisation Production Management a Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory	and Processes: Elective	Compulsory	
	Logistics and Mobility: Specialisation Production Management a Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory		: Compulsory	
	Logistics and Mobility: Specialisation Production Management a Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory	ective Compulsory		Processes: Flecti

Course L1085: Fundamentals	s of Materials Science I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471- 32013-7 P. Haasen: Physikalische Metallkunde. Springer 1994

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

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

Courses						
Title				Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD Ir	troduction and Practica	al Training (L0268)		Lecture	2	1
Mechanical Design Project I (L0695)	-	1	Project-/problem-based Learning	3	2
Mechanical Design Project II (L0592	2)		1	Project-/problem-based Learning	3	2
Feam Project Design Methodology	(L0267)		I	Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous						
Knowledge		s of Mechanical Engineering	g Design			
	Mechanics					
		s of Materials Science				
	 Production En 	gineering				
Educational Objectives	After taking part suc	cessfully, students have re	eached the following	g learning results		
Professional Competence						
Knowledge	After passing the mo	dule, students are able to:	:			
			and the second state of	to a local alternation comparison and	-l	
			parts e.g. consider	ing load situation, materials an	a manufactur	ing requirements
	describe basic		locianina			
	 explain basics 	methods of engineering d	lesigning.			
Skills	After passing the mo	dule, students are able to:	:			
	• independently	, create skatches, technica	drawings and dos	umontations of using 2D CAE	<u>,</u>	
		ments based on design gui		umentations e.g. using 3D CAD	ν,	
		ilculate) used components,		siy,		
				systematically and solution orig	ntod	
	 use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. 					
	apply clouder					
Personal Competence						
Social Competence	After passing the mo	odule, students are able to:	:			
	 develop and e 	evaluate solutions in group	s including making	and documenting decisions,		
		use of scientific methods,		, , , , , , , , , , , , , , , , , , ,		
	 moderate the use of sciencific methods, present and discuss solutions and technical drawings within groups, 					
		n results in the work group	-	5 1 .		
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. 					
Workload in Hours	Indonondont Study T	Time 40, Study Time in Lec	turo 140			
Credit points		Time 40, Study Time In Lee				
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaboration	Teamprojekt K	Construktionsmethodik		
	Yes None	Written elaboration	Konstruktionsp	projekt 1		
	Yes None	Written elaboration	Konstruktionsp	projekt 2		
	Yes None	Written elaboration	3D-CAD-Prakti	kum		
Examination	Written exam					
Examination duration and	180					
scale						
Assignment for the	General Engineering	Science (German program	n, 7 semester): Spe	cialisation Mechanical Engineer	ing: Compuls	ory
Following Curricula	General Engineering	Science (German program	n, 7 semester): Spe	cialisation Biomedical Engineer	ing: Compuls	ory
	General Engineering	Science (German program	n, 7 semester): Spe	cialisation Biomedical Engineer	ing: Compuls	ory
	Digital Mechanical E	ngineering: Core Qualificat	ion: Compulsory			
	Engineering Science	: Specialisation Mechatron	ics: Compulsory			
	Engineering Science	: Specialisation Mechanica	l Engineering: Com	pulsory		
	Engineering Science	: Specialisation Biomedical	Engineering: Comp	pulsory		
	Green Technologies:	Energy, Water, Climate: S	pecialisation Energ	y Technology: Elective Compute	sory	
	Mechanical Engineer	ring: Core Qualification: Co	mpulsory			
	Mechatronics: Core (Qualification: Compulsory				
	Naval Architecture: (Core Qualification: Compul	sony			

Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	 Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings
Literature	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. 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 D	esign Project I		
Тур	roject-/problem-based Learning		
Hrs/wk	3		
СР	2		
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42		
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	WiSe		
Content	 Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet 		
Literature	 Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. 		

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

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

Module M0680: Fluid D	lynamics		
	· · · · ·		
Courses			
Title	Тур	Hrs/wk	СР
Fluid Mechanics (L0454)	Lecture	3	4
Fluid Mechanics (L0455)	Recitation Section (large)	2	2
Module Responsible P	Prof. Thomas Rung		
Admission Requirements N	lone		
Recommended Previous S	itudents should have sound knowledge of engineering mathematics, engineering mechanics	and thermodyna	mics.
Knowledge			
Educational Objectives A	fter taking part successfully, students have reached the following learning results		
Professional Competence			
a n n	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. They are familiar with the similarities and differences between fluid mechanics and neighbouring subjects (thermodynamics, structural mechanics). Students can scientifically outline the rationale of flow physics using mathematical models. They are familiar with most performance analysis methods -in particular their realms and limitations- and the prediction of fluid engineering devices.		
to	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. They are able to explain physical relationships used to design fluid engineering devices. The lecture enables the student to carry out a necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.		
Personal Competence			
	The students are able to discuss problems, present the results of their own analysis, and jo address given technical goals.	intly develop so	lution strategies th
-	The students are able to develop solution strategies for complex problems self-consistent. Th esults as well as external data with regards to the plausibility and reliability.	ney are able to c	ritically analyse ov
Workload in Hours	ndependent Study Time 110, Study Time in Lecture 70		
Credit points 6			
Course achievement N	lone		
Examination V	Vritten exam		
Examination duration and 1	80 min		
scale			
Assignment for the G	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin	eering: Compuls	ory
-	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engine		-
-	General Engineering Science (German program, 7 semester): Specialisation Naval Architectur		-
	Acchanical Engineering: Core Qualification: Compulsory		
	laval Architecture: Core Qualification: Compulsory		
	echnomathematics: Specialisation III. Engineering Science: Elective Compulsory		

Course L0454: Fluid Mechan	ics
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	

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

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Anatomy (L0384)		Lecture	2	3
Module Responsible	Prof. Udo Schumacher			
Admission Requirements	None			
Recommended Previous	Students can listen to the lectures with	nout any prior knowledge. Basic school kno	wledge of biology, chem	nistry / biochemist
Knowledge	physics and Latin can be useful.			
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Educational Objectives Professional Competence	Arter taking part successiony, students in	lave reached the following learning results		
Knowledge	anatomy which is about organs and orga and to the central nervous system. The cross-sectional images. The Latin terms a		roduction to cell biology, escribed as well, using pl	human developme rojectional x-ray a
SKIIIS	functions of the human body. The Latin understand und further develop medical		edical literature. This kno	wledge is needed
	These insights in human anatomy are common diseases and their impact on th	the fundamentals to explain the role of str ne human body.	ructure and function for	the development
Personal Competence				
	The students can participate in current are prerequisite for communication with	discussions in biomedical research and med physicians on a professional level.	icine on a professional le	evel. The Latin ter
Autonomy		ne basics of anatomy and should encourage h further literature is suitable for this purp r about biomedical problems.		
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German pr	rogram, 7 semester): Specialisation Biomedic	al Engineering: Compulso	ory
Following Curricula	General Engineering Science (German	program, 7 semester): Specialisation Me	echanical Engineering, F	ocus Biomechan
	Compulsory			
	Data Science: Specialisation II. Application			
	Electrical Engineering: Specialisation Me			
	Engineering Science: Specialisation Biom			
		ogram, 7 semester): Specialisation Biomedica	al Engineering: Compulso	ry
	Mechanical Engineering: Specialisation B		ine Compular	
		ledical Technology and Control Theory: Election		
		lanagement and Business Administration: Ele		
		rtiticial Organs and Regenerative Medicines		
		rtificial Organs and Regenerative Medicine: E nplants and Endoprostheses: Elective Compu		

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

Courses					
.ourses litle		Tun	Hre /wk	CB	
ntreduction to Radiology and Radi	ation Therapy (L0383)	Typ Lecture	Hrs/wk 2	CP 3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
	After taking part successfully, students ha	ve reached the following learning results			
Professional Competence Knowledge	Therapy				
		es of currently used equipment with respect	to its use in radiation the	erapy.	
	The students can explain treatment plans	used in radiation therapy in interdisciplinary	, contexts (e.a. surgery	internal medicine)	
	The students can describe the patient	ts' passage from their initial admittanc	e through to follow-up	o care.	
	Diagnostics				
	The students can illustrate the technical	base concepts of projection radiography, ir	cluding angiography an	d mammography, a	
	well as sectional 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 thos				
	techniques.				
	The students can choose the right treatme	ent method depending on the patient's clinic	al 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 thera	by concepts and relate it to the radiation bic	logical aspects.		
	The students can use the therapeutic principle (effects vs adverse effects)				
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).				
	tumor, and choose the energy needed in t	nat situation (madiation planning).			
		ual psychosocial service should look like (e.g. follow-up treatment	t, sports, social he	
	groups, self-help groups, social services, p	sycho-oncology).			
	Diagnostics				
	The students can suggest solutions for rep	airs of imaging instrumentation after having	g done error analyses.		
	The students can classify results of imac	ing techniques according to different grou	ps of diseases based or	n their knowledge	
	anatomy, pathology and pathophysiology.				
Personal Competence					
	The students can assess the special social	situation of tumor patients and interact wit	h them in a professional	way.	
	The students are aware of the special,	often fear-dominated behavior of sick pe	ople caused by diagnos	stic and therapeut	
	measures and can meet them appropriate	ly.			
Autonomy	The students can apply their new knowled	ge and skills to a concrete therapy case.			
	The students can introduce younger stude	nts to the clinical daily routine.			
	The students are able to access anatomic	al knowledge by themselves, can participa	te competently in conve	rsations on the top	
	and acquire the relevant knowledge them:	selves.			
Workload in Hours	Independent Study Time 62, Study Time ir	Lecture 28			
Credit points					
Course achievement	None				
Examination	Written exam				
	90 minutes				
scale	Conoral Engineering Science (Cormon pro	arom 7 competer), Enocialization Riemodic	L Engineering, Compuls	201	
Following Curricula		gram, 7 semester): Specialisation Biomedica program, 7 semester): Specialisation Me			
	Compulsory		, <u> </u>		
	Data Science: Specialisation II. Application				
	Electrical Engineering: Specialisation Medi				
	Engineering Science: Specialisation Biome General Engineering Science (English proc	dical Engineering: Compulsory ram, 7 semester): Specialisation Biomedica	l Engineering: Compulso	rv	
	Mechanical Engineering: Specialisation Bio		gcompulso	.,	
		dical Technology and Control Theory: Electiv	ve Compulsory		
		nagement and Business Administration: Ele			
		ificial Organs and Regenerative Medicine: E plants and Endoprostheses: Elective Compu			
	ENTREPART ENTREETING, SUBURISOUUN IM				

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Courses					
Title		Тур	Hrs/wk	СР	
Computational Mechanics (Exercises) (L1138)		Recitation Section (small)	2	2	
Computational Multibody Dynamics (L1137)		Integrated Lecture	2	2	
Computational Stuctural Mechanics	; (L2475)	Integrated Lecture	2	2	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous	Mathematics I-III and Engineering Mechanics	1-111			
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	The students can				
	describe the axiomatic procedure used				
	explain important steps in model design	jn;			
	 present technical knowledge. 				
Skills	The students can				
	 explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context their own problems; 				
	their own problems;apply basic methods from numerical mechanics to engineering problems;				
				aata	
	• estimate the reach and boundaries of	the methods and extend them to be applicable t	o wider problem:	sets.	
Personal Competence					
Social Competence	The students can work in groups and support	each other to overcome difficulties.			
Autonomy	Students are capable of determining their ow	n strengths and weaknesses and to organize the	eir time and learn	ing based on those	
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical Engir	eerina: Compulso	orv	
Following Curricula		am, 7 semester): Specialisation Biomedical Engin		-	
<u> </u>		am, 7 semester): Specialisation Naval Architectur			
	Energy Systems: Technical Complementary (•			
	Mechanical Engineering: Core Qualification: 0				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Comp	ulsory			
	Technomathematics: Specialisation III. Engine				
	Theoretical Machanical Engineering, Technics	al Complementary Course Core Studies: Elective	Compulsory		

Course L1138: Computationa	Course L1138: Computational Mechanics (Exercises)		
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, Prof. Christian Cyron		
Language	DE		
Cycle	SoSe		
Content			
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).		
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).		

Course L1137: Computationa	Il Multibody Dynamics
Тур	Integrated Lecture
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	 Linear versus nonlinear vibration Numerical methods for time integration Concepts from analytical mechanics Spatial multibody systems Linearization of multibody systems Vibrations with multiple degrees of freedom: free, damped, forced, modal transformation Impacts Introduction to Matlab
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L2475: Computationa	Il Stuctural Mechanics
Тур	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	The lecture Computational Structural Mechanics extends the content of the lecture Engineering Mechanic II. It bridges the gap between the manual calculation of mechanical stress and deformation in systems with a particularly simple geometry and the efficent computer-based computation of general mechanical systems: • Basics of linear continuum mechanics • Planar structures: plate, membrane, slab • Linientragwerke: beam, cable, truss • Weak form and Galerkin's method • Finite element method: theory and application • Principles of mechanics: principle of virtual work, virtual displacements, virtual forces
Literature	Gross, Hauger, Wriggers, "Technische Mechanik 4", Springer

Courses		
Title	Typ Hrs/wk CP	
Numerical Mathematics I (L0417)	Lecture 2 3	
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3	
Module Responsible	e Prof. Sabine Le Borne	
Admission Requirements	s None	
Recommended Previous	s	
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomath basic MATLAB/Python knowledge 	iematici
Educational Objectives	s After taking part successfully, students have reached the following learning results	
Professional Competence	e	
Knowledge	e Students are able to	
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear r problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage comp 	
Skills	/s Students are able to	
	 implement, apply and compare numerical methods using MATLAB/Python, justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, select and execute a suitable solution approach for a given problem. 	
Personal Competence	e	
Social Competence	e Students are able to	
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background ki explain theoretical foundations and support each other with practical aspects regarding the implementation of alg 	
Autonomy	y Students are capable	
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team, to assess their individual progess and, if necessary, to ask questions and seek help. 	
Workload in Hours	s Independent Study Time 124, Study Time in Lecture 56	
Credit points	s 6	
Course achievement	t None	
Examination	n Written exam	
Examination duration and	d 90 minutes	
	3	
scale		
scale Assignment for the	e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	
scale Assignment for the		mechan
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory 	
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical 1 Engineering: Compulsory 	Mechan
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf 	Mechani
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf 	Mechan ft Syste
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory 	Mechan ft Syste cs: Elect
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 	Mechan ft Syste cs: Elect
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 	Mechan ft Syste cs: Elect
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory 	Mechani ft Syste cs: Elect / Syster
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical 1 Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical 1 Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy 	Mechani ft Syste cs: Elect / Syster
scale Assignment for the	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Bior Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical I Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraf Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory 	Mechani ft Syste cs: Elect / Syster
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Course L0417: Numerical Ma	thematics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sabine Le Borne
Language	EN
Cycle	WiSe
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods
	 Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer

Course L0418: Numerical Ma	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. Jens-Peter Zemke		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0684: Heat				
Courses				
Title	Тур	Hrs/wk	СР	
Heat Transfer (L0458)		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 results			
Professional Competence				
Knowledge	The students can			
	- explain the technical terms,			
	- classify the various physical processes of heat transfer in terms of conduction-based and radiation	on-based mecl	hanisms,	
	- simplify and critically analyze complex heat transfer processes using models,			
	- methodically develop solutions to tasks.			
Skills	s The students are able to			
	- describe the physics of the different Heat Transfer mechanism,			
	- simplifywith models, calculate and evaluate complex Heat Transfer processes,			
	- critically question and answer statements on heat transfer,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
	In lectures and exercises, the students can use many examples and experiments to discuss in manner, develop a solution and present it. Within the exercises, the students can independent work out targeted solutions.			
Autonomy	The students can check their level of knowledge by means of repetition questions at the beginning of the lectures and describe discuss answers in exchange with the other students. In the exercises, the students work in small groups on the methods taugh the lectures in complex tasks and critically analyze the results in the auditorium.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir	neering, Focu	s Energy Syster	
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering	ng: Compulsor	У	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri	ng, Focus The	oretical Mechani	
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory			
	Integrated Building Technology: Core Qualification: Compulsory			
	Mechanical Engineering: Specialisation Energy Systems: Compulsory			
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory			

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, Heat Conduction (steady and unsteady) , Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

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

Courses					
Title		Тур	Hrs/wk	СР	
Practical Course: Measurement and	d Control Systems (L1119)	Practical Course	2	2	
Measurement Technology for Mech	nanical Engineering (L1116)	Lecture	2	3	
Measurement Technology for Mech	anical Engineering (L1118)	Recitation Section (large)	1	1	
Module Responsible	Prof. Thorsten Kern				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering				
Educational Objectives	After taking part successfully, students have a	reached the following learning results			
Professional Competence					
Knowledge	e Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncert Calibration, Static and Dynamic Properties of Sensors and Systems). They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quar				
	Temperature, mechanical quantities, Flow, Ti		o be maesured (
	They can describe important methods of cher	nical Analysis (Gas Sensors, Spectroscopy, Gas	Chromatography)		
Skills	Students can select suitable measuring metho	ods to given problems and can use refering mea	asurement device	s in practice.	
	The students are able to orally explain issues in the subject area of measurement technology and solution applace the issues into the right context and application area.				
Personal Competence					
Social Competence	Students can arrive at work results in groups and document them in a common report.				
	Students are able to familiarize themselves with new measurement technologies.				
	Independent Study Time 110, Study Time in L	ecture 70			
Credit points					
Course achievement	Compulsory Bonus Form Yes None Subject theoretical	Description			
	practical work	and			
Examination	Subject theoretical and practical work				
Examination duration and					
scale					
Scale			a coring Compuls	254	
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		m, 7 semester): Specialisation Mechanical Engir			
	General Engineering Science (German progra	m, 7 semester): Specialisation Biomedical Engir	neering: Compulso	bry	
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	se: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine wi 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
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl. Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg. Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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

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

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and M	olecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	 explain how genetic information 	is coded in the DNA.		
	 explain the connection between 			
Skills	The students can			
	 recognize the importance of mole 	ecular parameters for the course of a disease;		
	describe selected molecular-diag	•		
	 explain the relevance of these pr 	•		
Personal Competence				
Social Competence	The students can participate in discussi	ions in research and medicine on a technical lev	/el.	
	Students will have an improved under	standing of current medical problems (e.g. C	orona pandemic)and will	be able to exp
	these issues to others.			
Autonomy	The students can develop an understan	ding of topics from the course, using technical	literature, by themselves	
	Students will be better equipped to reco	ognize fake news in the media regarding medic	al research topics	
	Students will be better equipped to rect	synze rake news in the mean regarding mean	arresearen topies.	
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
	General Engineering Science (German	program, 7 semester): Specialisation Biomedica	l Engineering: Compulso	~v
•		n program, 7 semester): Specialisation Med		-
	Compulsory			
	Electrical Engineering: Specialisation M	edical Technology: Elective Compulsory		
	Engineering Science: Specialisation Bio	medical Engineering: Compulsory		
	General Engineering Science (English p	rogram, 7 semester): Specialisation Biomedical	Engineering: Compulsor	/
	Mechanical Engineering: Specialisation			
		Management and Business Administration: Elec		
	5 5 1	Artificial Organs and Regenerative Medicine: El		
		Medical Technology and Control Theory: Electiv		
		Implants and Endoprostheses: Elective Compute	SULA	
	recimomatiematics: specialisation III. I	Engineering Science: Elective Compulsory		

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

Module M1333: BIO I:	Implants and Fracture Heali	ng		
Courses				
Title		Тур	Hrs/wk	СР
Implants and Fracture Healing (L03	76)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Introc	duction into Anatomie" before attending "Impl	ants and Fracture Heal	ing".
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different wa	ays how bones heal, and the requirements for	their existence.	
	The students can name different treatmen	nts for the spine and hollow bones under giver	fracture morphologies	i.
Skills	The students can determine the forces act	ting within the human body under quasi-static	situations under speci	fic assumptions.
Personal Competence				
•	The students can, in groups, solve basic n	umerical modeling tasks for the calculation of	internal forces.	
Autonomy	The students can, in groups, solve basic n	umerical modeling tasks for the calculation of	internal forces.	
Workload in Hours	Independent Study Time 62, Study Time ir	n Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mech	anical Engineering, F	ocus Biomechanio
Following Curricula	Compulsory			
	General Engineering Science (German pro	gram, 7 semester): Specialisation Biomedical	Engineering: Compulso	ory
	Engineering Science: Specialisation Biome	edical Engineering: Compulsory		
	General Engineering Science (English prog	gram, 7 semester): Specialisation Biomedical B	Ingineering: Compulso	У
	Mechanical Engineering: Specialisation Bio	omechanics: Compulsory		
	Biomedical Engineering: Specialisation Imp	plants and Endoprostheses: Elective Compulse	ory	
	Biomedical Engineering: Specialisation Art	ificial Organs and Regenerative Medicine: Ele	ctive Compulsory	
	Biomedical Engineering: Specialisation Ma	nagement and Business Administration: Elect	ive Compulsory	
	Biomedical Engineering: Specialisation Me	edical Technology and Control Theory: Elective	Compulsory	
	Orientation Studies: Core Qualification: Ele		· -	
	Technomathematics: Specialisation III. Eng			

Course L0376: Implants and	Fracture Healing
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE
Cycle	
Content	Topics to be covered include: 1. Introduction (history, definitions, background importance)
	2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
	3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine 3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
	5 Fracture Healing
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates 5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
Literature	Cochran V.B.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

Courses					
Title			Тур	Hrs/wk	СР
Introduction into Medical Technolog			Lecture	2	3
ntroduction into Medical Technolog				2	
ntroduction into Medical Technolog			Recitation Section (large)	1	1
Module Responsible		aefer			
Admission Requirements	None				
Recommended Previous					
Knowledge	principles of stochas				
	principles of program	nming, R/Matlab			
Educational Objectives	After taking part suce	cessfully, students have reach	ed the following learning results		
Professional Competence					
Knowledge	The students can ex	xplain principles of medical t	echnology, including imaging systems, o	computer aided s	urgery, and med
	information systems.	They are able to give an over	view of regulatory affairs and standards in	n medical technolo	ogy.
C1:11-	The shudents are abl			l'antinua.	
SKIIIS	The students are able	e to evaluate systems and me	dical devices in the context of clinical app	lications.	
Personal Competence					
Social Competence	The students describ	e a problem in medical techno	logy as a project, and define tasks that ar	re solved in a joint	effort.
	The students can crit	cically reflect on the results of	other groups and make constructive sugg	estions for improv	vement.
Autonomy	The students can as	ssess their level of knowledg	e and document their work results. Th	ney can critically	evaluate the rest
Autonomy		ssess their level of knowledg t them in an appropriate manr		ney can critically	evaluate the rest
-	achieved and presen	t them in an appropriate mann	ner.	ney can critically	evaluate the rest
Workload in Hours	achieved and presen Independent Study T	-	ner.	ney can critically	evaluate the resi
Workload in Hours Credit points	achieved and presen Independent Study T 6	t them in an appropriate mann	ner. e 70	ney can critically	evaluate the res
Workload in Hours	achieved and presen Independent Study T 6 Compulsory Bonus	t them in an appropriate manning from the study time in Lectur	ner.	ey can critically	evaluate the resu
Workload in Hours Credit points	achieved and presen Independent Study T 6 Compulsory Bonus Yes 10 %	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration	ner. e 70	ey can critically	evaluate the reso
Workload in Hours Credit points Course achievement	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Yes 10 %	t them in an appropriate manning from the study time in Lectur	ner. e 70	ey can critically	evaluate the reso
Workload in Hours Credit points Course achievement Examination	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written examples	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration	ner. e 70	ey can critically	evaluate the reso
Workload in Hours Credit points Course achievement	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written examples	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration	ner. e 70	ey can critically	evaluate the res
Workload in Hours Credit points Course achievement Examination Examination duration and scale	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation	e 70 Description		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Yes 10 % Written exam 90 minutes General Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 s	e 70 Description semester): Specialisation Biomedical Engli	neering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Yes 10 % Written exam 90 minutes General Engineering Computer Science: S	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 s pecialisation II. Mathematics a	e 70 Description semester): Specialisation Biomedical Englin nd Engineering Science: Elective Compuls	neering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a lisation II. Application: Elective	e 70 Description Seemester): Specialisation Biomedical Englin nd Engineering Science: Elective Compuls e Compulsory	neering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core C	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 s pecialisation II. Mathematics a	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry	neering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core Q Electrical Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a ilisation II. Application: Elective Qualification: Elective Compulse	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory ory Compulsory	neering: Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science:	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory ory Compulsory	neering: Compulso	ory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science: General Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng Science (English program, 7 s	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry Compulsory jineering: Compulsory	neering: Compulso	ory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science: General Engineering Computer Science in	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng Science (English program, 7 s Engineering: Specialisation II.	e 70 Description Semester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry Compulsory jineering: Compulsory emester): Specialisation Biomedical Englin	neering: Compulso sory teering: Compulsory	ory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science: General Engineering Computer Science in Biomedical Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng Science (English program, 7 s Engineering: Specialisation II. ing: Specialisation Artificial Org	e 70 Description Semester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry Compulsory jineering: Compulsory emester): Specialisation Biomedical Englin Mathematics & Engineering Science: Elec	neering: Compulso sory teering: Compulsory	ory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science: General Engineering Computer Science in Biomedical Engineering Biomedical Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng Science (English program, 7 s Engineering: Specialisation II. ing: Specialisation Implants an	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry Compulsory jineering: Compulsory emester): Specialisation Biomedical Englin Mathematics & Engineering Science: Elec gans and Regenerative Medicine: Elective	neering: Compulso sory teering: Compulsory Compulsory	ory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	achieved and present Independent Study T 6 Compulsory Bonus Yes 10 % Written exam 90 minutes General Engineering Computer Science: S Data Science: Specia Data Science: Specia Data Science: Core Q Electrical Engineering Engineering Science: General Engineering Computer Science in Biomedical Engineeri Biomedical Engineering	t them in an appropriate mann ime 110, Study Time in Lectur Form Written elaboration Presentation Science (German program, 7 s pecialisation II. Mathematics a disation II. Application: Elective Qualification: Elective Compuls g: Core Qualification: Elective Specialisation Biomedical Eng Science (English program, 7 s Engineering: Specialisation II. ing: Specialisation Artificial Org ing: Specialisation Implants an ing: Specialisation Medical Tec	e 70 Description Seemester): Specialisation Biomedical Engli nd Engineering Science: Elective Compuls e Compulsory pry Compulsory ineering: Compulsory emester): Specialisation Biomedical Englin Mathematics & Engineering Science: Elective gans and Regenerative Medicine: Elective d Endoprostheses: Elective Compulsory	neering: Compulso sory tive Compulsory Compulsory npulsory	ory

Course L0342: Introduction i	nto 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	Bernhard Priem, "Visual Computing for Medicine", 2014
	Heinz Handels, "Medizinische Bildverarbeitung", 2009 (https://katalog.tub.tuhh.de/Record/745558097)
	Valery Tuchin, "Tissue Optics - Light Scattering Methods and Instruments for Medical Diagnosis", 2015
	Olaf Drössel, "Biomedizinische Technik - Medizinische Bildgebung", 2014
	H. Gross, "Handbook of Optical Systems", 2008 (https://katalog.tub.tuhh.de/Record/856571687)
	Wolfgang Drexler, "Optical Coherence Tomography", 2008
	Kramme, "Medizintechnik", 2011
	Thorsten M. Buzug, "Computed Tomography", 2008
	Otmar Scherzer, "Handbook of Mathematical Methods in Imaging", 2015
	Weishaupt, "Wie funktioniert MRI?", 2014
	Paul Suetens, "Fundamentals of Medical Imaging", 2009
	Vorlesungsunterlagen

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	See interlocking course
Literature	See interlocking course

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 the basics of the chergy metabolish; 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, developm
	of forces and vital functions) and relate them to similar technical systems.
Personal Competence	
Social Competence	The students can conduct discussions in research and medicine on a technical level.
	The students can find solutions to 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
	themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	
Course achievement	
Examination	Written exam
Examination duration and	
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
-	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar
	Compulsory
	Data Science: Specialisation Medicine: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory 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 L0385: Introduction to Physiology	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Gerhard Engler
Language	DE
Cycle	SoSe
Content	
Literature	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme
	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier

Courses						
Title				Tue	Hrs/wk	СР
Computer Science for Engineers - F	Programming Concepts, Data Ha	andling & Communication (12689)	Typ Lecture	3	3
Computer Science for Engineers - F		-		Recitation Section (small)	2	3
Module Responsible		-				
Admission Requirements						
Recommended Previous						
Knowledge						
Educational Objectives	After taking part successful	v. students have reache	d the followi	ng learning results		
Professional Competence	······ ·······························	,,				
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Time 11	0, Study Time in Lecture	e 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
		station 1	l estate finde	n semesterbegleitend statt.		
Examination	Written exam					
Examination duration and	120 min					
scale	Concerl Frazina ania a Caisa		7) Considiration Machanica	L En sin serie s - E	Diana akani
Following Curricula		ice (German program,	/ semeste	r): Specialisation Mechanica	i Engineering, r	ocus biomechanic
Following curricula	Compulsory	e (German program 7 se	amastar): Sn	ecialisation Biomedical Engin	eering: Compuls	
				ecialisation Green Technolog		
	Compulsory	e (eerman program) / ee	ennester), sp			
		ce (German program, 7	7 semester):	Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory				5 5.	5, ,
	General Engineering Scien	ce (German program, 7	7 semester)	Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Compulsory					
	General Engineering Scier	ice (German program,	7 semeste	r): Specialisation Mechanica	al Engineering, I	ocus Mechatroni
	Compulsory					
	General Engineering Science	e (German program, 7 s	semester): S	pecialisation Mechanical Eng	ineering, Focus F	roduct Developme
	and Production: Elective Co	mpulsory				
				ecialisation Electrical Enginee		
			emester): Sp	ecialisation Mechanical Engin	neering, Focus Th	eoretical Mechani
	Engineering: Elective Comp	-				
	Bioprocess Engineering: Cor		-			
	Chemical and Bioprocess Er			льогу		
	Electrical Engineering: Core			gy Systems: Elective Compul	sony	
	Logistics and Mobility: Spec				501 y	
	Mechatronics: Core Qualifica		ciniology. Ct	inipuisol y		
	Process Engineering: Core Q		/			
				pecialisation Information Tec	hnology: Comput	sorv
	and manageme					

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

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

Courses	
Title	Typ Hrs/wk CP
Experimental Methods in Biomecha	
Module Responsible	Prof. Michael Morlock
Admission Requirements	
	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The course deals with common experimental methods used in biomechanics. For each topic an overview and some basic practi knowledge is provided.
	1. Tribology
	2. Optical Methods
	3. Motion Analysis
	4. Pressure Distribution
	5. Strain Gauges
	6. Pre-clinical testing
	7. Specimen Preparation and Storage
	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.
	The students can describe different measurement techniques for forces and movements, and choose the adequate technique for given task.
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.
Personal Competence	
Social Competence	Students are able to organize themselves as a group to solve simple experimental tasks together. On the one hand, the division tasks must be organized during the experiment as well as during the short written elaboration, but on the other hand, to knowledge acquired must be available to all participants of the group afterwards. The challenge here is that the topics char quickly because fundamentally different measurement principles are taught. In addition, a strict time management is expected.
Autonomy	Students perform simple experimental tasks in small groups or create simple sensors (e.g. strain gauges). The preceding lect serves as a basis for these experiments. As preparation or follow-up, the theoretical knowledge has to be worked up and related the experimental result. In particular, independent transfer performance is necessary to clarify why experimental observations of show deviations from the theoretical values and how these deviations can be compensated.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Course achievement	None
Examination	Written exam
Examination duration and	90 min
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani
Following Curricula	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0377: Experimental	Methods in Biomechanics
•	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE
Cycle	SoSe
Content	The course deals with common experimental methods used in biomechanics. For each topic an overview and some basic practical
	knowledge is provided.
	1. Tribology
	2. Optical Methods
	3. Motion Analysis
	4. Pressure Distribution
	5. Strain Gauges
	6. Pre-clinical testing
	7. Specimen Preparation and Storage
Literature	Hoffmann K., Eine Einführung in die Technik des Messens mit Dehnmessstreifen
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	white A.A., Fahjabi M.M. Chilical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
	Online Hilfe von Mathworks: https://de.mathworks.com/help/matlab/

Specialization Naval Architecture

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

Module M1118: Hydro	ostatics 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 Me	chanics I-III.		
Knowledge	It is recommended that the students are fami	liar with typical design relevant drawings, e.g. B	ody Plan, GA- Pla	an, Tank Plan etc.
Educational Objectives	After taking part successfully, students have i	reached the following learning results		
Professional Competence				
Knowledge	The lecture enables the student to carry out all necessary theoretical calculations for ship design on a scientific level. The lecture			
	is basic requirement for all following lectures	in the subjects shipo design and safety of ships.		
CI-:!!-	The shudded is able to second out budge static			
Skills	The student is able to carry out hydrostatic calculations to ensure that the ship has sufficient stability. He is able to design hul			
	forms that are safe against capsizing or sinkir	ıg.		
Personal Competence				
Social Competence	The student gets access to hydrostatical prob	lems.		
Autonomy				
	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Naval Architectur	re: Compulsory	
Following Curricula	Naval Architecture: Core Qualification: Compu	Ilsory		

Course L1260: Hydrostatics		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content	1. Numerical Integration, Diffrentation, Interpolation	
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods	
	- Determination of Areas, 1st and 2nd order Moments	
	- Numerical Diffrentation, Spline Interpolation	
	2. Buyoancy	
	- Principle of Archimedes	
	- 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
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1452: Body Plan	
Тур	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	 Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Courses				
Courses		_		
Title	1 (11005)	Тур	Hrs/wk	CP
Fundamentals of Materials Science Fundamentals of Materials Science	I (L1085) II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2 2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible				
Admission Requirements				
	Highschool-level physics, chemistry und mathematics			
Knowledge	ingliserioor level physics, enemisery and matternates			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence	Arter taking part successiony, students have reached the follow	ang learning results		
-	The students have acquired a fundamental knowledge on r	metals ceramics and	nolymers and can descr	ribe this knowled
Knowledge	comprehensively. Fundamental knowledge here means specific			
	phase transformations, corrosion and mechanical properties. Th			
	for materials and can identify relevant approaches for cha			
	phenomena back to the underlying physical and chemical laws		roperties. They are able	
	······································			
Skills	The students are able to trace materials phenomena back t	to the underlying phy	sical and chemical laws	of nature. Mater
	phenomena here refers to mechanical properties such as stre	ngth, ductility, and st	iffness, chemical propertie	es such as corros
	resistance, and to phase transformations such as solidificatio	n, precipitation, or m	nelting. The students can	explain the relat
	between processing conditions and the materials microstructu	ure, and they can acc	count for the impact of m	icrostructure on
	material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Mechani	cal Engineering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Biomedio	cal Engineering: Compulso	ory
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Ar	chitecture: Compulsory	
	General Engineering Science (German program, 7 semester): S		d Materials: Compulsory	
	Data Science: Specialisation II. Application: Elective Compulsory	-		
	Digital Mechanical Engineering: Core Qualification: Compulsory			
	Green Technologies: Energy, Water, Climate: Specialisation Ene		tive Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elect			
	Logistics and Mobility: Specialisation Production Management a	nd Processes: Elective	e Compulsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Marchaether Come Overlification Communication			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Ele			
	Naval Architecture: Core Qualification: Compulsory		duction Management and	Processes: Elect

Course L1085: Fundamentals of Materials Science I Тур Lecture Hrs/wk СР Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Jörg Weißmüller Language DE Cycle WiSe Content Literature Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 P. Haasen: Physikalische Metallkunde. Springer 1994

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

Course L1095: Physical and O	Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Gregor Vonbun-Feldbauer
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

matics IV			
	Тур	Hrs/wk	СР
erential Equations) (L1043)	Lecture	2	1
erential Equations) (L1044)	Recitation Section (small)	1	1
erential Equations) (L1045)	Recitation Section (large)	1	1
		2	1
			1
	Recitation Section (large)	L	1
Prof. Anusch Taraz			
None			
Mathematics I - III			
After taking part successfully, students have reached th	o following loarning rocults		
After taking part successiony, students have reached th	e following learning results		
Ctudents can name the basis concents in Mathem	atics N/ Thou are able to evoluin the	musing oppropris	ata avamplas
 Students can discuss logical connections betwee 	n these concepts. They are capable	or illustrating the	ese connections w
the help of examples.			
They know proof strategies and can reproduce th	em.		
 Students can model problems in Mathematics IV 	' with the help of the concepts studie	ed in this course	. Moreover, they a
capable of solving them by applying established r	methods.		
		nts studiod in the	COURSO
-	-		
 For a given problem, the students can develop 	and execute a suitable approach, a	nd are able to ci	ritically evaluate t
results.			
 Students are able to work together in teams. The 	y are capable to use mathematics as	a common langua	age.
design examples to check and deepen the unders	standing of their peers.		
 Students are capable of checking their understar 	nding of complex concepts on their o	wn. They can sp	ecifv open auestio
		in inc) can op	ceny open questio
 Students have developed sufficient persistence 	to be able to work for longer period	s in a goal-orien	ted manner on ha
problems.			
Independent Study Time 68 Study Time in Lecture 112			
60 min (Complex Functions) + 60 min (Differential Four	tions 2)		
Concret Engineering Colones (Cormon program 7 come	star), Cresislication Flastrical Engine	ning. Compulson	
General Engineering Science (German program, 7 s	semester): Specialisation Mechanica	I Engineering, I	ocus Mechatroni
Compulsory			
	ster): Specialisation Naval Architectur	e: Compulson	
	•		
General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani
Engineering: Elective Compulsory			
Electrical Engineering: Core Qualification: Compulsory			
	ter): Specialisation Electrical Engineer	ring: Compulsory	
Electrical Engineering: Core Qualification: Compulsory			
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semes Computer Science in Engineering: Specialisation II. Math	nematics & Engineering Science: Elect		
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semes Computer Science in Engineering: Specialisation II. Math Mechanical Engineering: Specialisation Mechatronics: Co	nematics & Engineering Science: Elect	ive Compulsory	
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semes Computer Science in Engineering: Specialisation II. Math Mechanical Engineering: Specialisation Mechatronics: Co Mechanical Engineering: Specialisation Theoretical Mech	nematics & Engineering Science: Elect	ive Compulsory	
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semes Computer Science in Engineering: Specialisation II. Math Mechanical Engineering: Specialisation Mechatronics: Co	nematics & Engineering Science: Elect	ive Compulsory	
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semes Computer Science in Engineering: Specialisation II. Math Mechanical Engineering: Specialisation Mechatronics: Co Mechanical Engineering: Specialisation Theoretical Mech	nematics & Engineering Science: Elect	ive Compulsory	
	 Students can name the basic concepts in Mathem Students can discuss logical connections betwee the help of examples. They know proof strategies and can reproduce th Students can model problems in Mathematics IV capable of solving them by applying established r Students are able to discover and verify further loging and verify further loging is a given problem, the students can develop results. Students are able to work together in teams. The In doing so, they can communicate new concepts design examples to check and deepen the understan precisely and know where to get help in solving ti Students have developed sufficient persistence problems. Independent Study Time 68, Study Time in Lecture 112 Mone Written exam Go min (Complex Functions) + 60 min (Differential Equa General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme 	Prof. Anusch Taraz None Prof. Anusch Taraz None Prof. Anusch Taraz None Atter taking part successfully, students have reached the following learning results Atter taking part successfully, students have reached the following learning results Students can name the basic concepts in Mathematics IV. They are able to explain their Students can name the basic concepts in Mathematics IV. They are capable the help of examples. They know proof strategies and can reproduce them. Students are able to discover and verify further logical connections between the concepts. Students are able to discover and verify further logical connections between the conce For a given problem, the students can develop and execute a suitable approach, a results. Students are able to work together in teams. They are capable to use mathematics as. Indoing so, they can communicate new concepts according to the needs of their coop design examples to check and deepen the understanding of complex concepts on their o precisely and know where to get help in solving them. Students study Time 68, Study Time in Lecture 112 6 None Written exam Go min (Complex Functions) + 60 min (Differential Equations 2)	Typ Hrs/wk secture 2 rential Equations) (L1043) Recitation Section (small) 1 sectuation Section (large) 1 Recitation Section (small) 1 After taking part successfully, students have reached the following learning results 1 • Students can name the basic concepts in Mathematics IV. They are able to explain them using appropria 1 • Students can model problems in Mathematics IV with the help of the concepts studied in this course capable of solving them by applying established methods. 1 • Students are able to discover and verify further logical connections between the concepts studied in the for a given problem, the students can develop and execute a suitable approach, and are able to cresults. • Students are able to work together in teams. They are capable to use mathematics as a common langum precis

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

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

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

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

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

Course L1042: Complex Fund	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	
Computational Mechanics (Exercise	es) (L1138)	Recitation Section (small)	2	2	
Computational Multibody Dynamic	s (L1137)	Integrated Lecture	2	2	
Computational Stuctural Mechanic	s (L2475)	Integrated Lecture	2	2	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous	Mathematics I-III and Engineering Mechanic	cs I-III			
Knowledge					
Educational Objectives	After taking part successfully, students have	ve reached the following learning results			
Professional Competence					
Knowledge	The students can				
	describe the axiomatic procedure us				
	explain important steps in model de	isign;			
	 present technical knowledge. 				
Skills	The students can				
	 explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of the important elements. 				
	their own problems;				
	 apply basic methods from numerical mechanics to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 				
	estimate the reach and boundaries of	of the methods and extend them to be applicable to	o wider problem	sets.	
Personal Competence					
Social Competence	The students can work in groups and supp	ort each other to overcome difficulties.			
Autonomy	Students are capable of determining their	own strengths and weaknesses and to organize the	ir time and learn	ing based on those	
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and					
scale					
Assignment for the	General Engineering Science (German prod	gram, 7 semester): Specialisation Mechanical Engin	eerina: Compuls	orv	
Following Curricula		gram, 7 semester): Specialisation Biomedical Engin		-	
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory				
	Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory				
	Mechanical Engineering: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compuis				
	Naval Architecture: Core Qualification: Computer	npulsory			
	Naval Architecture: Core Qualification: Con Technomathematics: Specialisation III. Eng		Compulsory		

Course L1138: Computationa	il Mechanics (Exercises)
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, Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011).

Course L1137: Computationa	I Multibody Dynamics
Тур	Integrated Lecture
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	 Linear versus nonlinear vibration Numerical methods for time integration Concepts from analytical mechanics Spatial multibody systems Linearization of multibody systems Vibrations with multiple degrees of freedom: free, damped, forced, modal transformation Impacts Introduction to Matlab
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L2475: Computationa	Il Stuctural Mechanics
Тур	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	The lecture Computational Structural Mechanics extends the content of the lecture Engineering Mechanic II. It bridges the gap
	between the manual calculation of mechanical stress and deformation in systems with a particularly simple geometry and the
	efficent computer-based computation of general mechanical systems:
	Basics of linear continuum mechanics
	Planar structures: plate, membrane, slab
	Linientragwerke: beam, cable, truss
	Weak form and Galerkin's method
	Finite element method: theory and application
	Principles of mechanics: principle of virtual work, virtual displacements, virtual forces
Literature	Gross, Hauger, Wriggers, "Technische Mechanik 4", Springer

Module M0680: Fluid	Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Students should have sound knowledge of engineering mathe	ematics, engineering mechanics	and thermodyna	mics.
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll-	owing learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. They are familiar with the similarities and differences between fluid mechanics and neighbouring subjects (thermodynamics, structura mechanics). Students can scientifically outline the rationale of flow physics using mathematical models. They are familiar with most performance analysis methods -in particular their realms and limitations- and the prediction of fluid engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. They are able to explain physical relationships used to design fluid engineering devices. The lecture enables the student to carry out a necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems, present the resu address given technical goals.	ılts of their own analysis, and jo	ointly develop sol	ution strategies th
Autonomy	The students are able to develop solution strategies for com results as well as external data with regards to the plausibilit		hey are able to c	ritically analyse ov
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engin	eering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 semester):	Specialisation Naval Architectur	e: Compulsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: I	Elective Compulsory		

Course L0454: Fluid Mechani	ics
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	 the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg.

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

Courses					
Title		Тур	Hrs/wk	СР	
Ship Dynamics (L0352)		Lecture	2	3	
Ship Dynamics (L1620)		Recitation Section (small)	1	1	
	in Naval Architecure and Ocean Engineering (L0364)	Lecture	2	3	
	Prof. Moustafa Abdel-Maksoud				
Admission Requirements	None				
Recommended Previous Knowledge	Technical mechanics				
Kilowieuge	 Linear algebra, analysis, complex numbers 				
	Fluid mechanics				
Educational Objectives	After taking part successfully, students have reached the	e following learning results			
Professional Competence					
Knowledge	- The students are able to give an overview over various	manoeuvres. They can name applica	ation goals and t	hey can describe t	
	procedure of the manoeuvres.				
	- The students are able to give an overview over varius rudder types. They can name criteria in the rudder design.				
	- The students can name computation methods which are used to determine 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 them.				
	- The students are able to determine hydrodynamic coefficients and they can explain their physical meaning.				
	- The students can explain how a rudder works and they can explain the physical effects which can occur.				
	- The students can mathematically describe waves.				
	- The students can explain the mathematically description	on of harmoncial motions in waves an	d they can deter	nine them.	
Personal Competence					
-	- The students can arrive at work results in groups and d	ocument them.			
,					
	- The students can discuss in groups and explain their po	bint of view.			
Autonomy	- The students can assess their own strengthes and wea	knesses and the define further work s	teps on this basi	s.	
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70				
Credit points	7				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 min				
scale					

se L0352: Ship Dynamic	
Тур	
Hrs/wk	
СР	
Workload in Hours	
	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 Universit Hamburg-Harburg, 2014 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University Technology, 2014 Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, Unit 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 ar 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

ourse 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

	Stochastic Processes in Naval Architecure and Ocean Engineering
<i>,</i> ,	
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Wassermann
Language	DE
Cycle	WiSe
Content	 descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	 V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, John Wiley & Sons, Inc., Nev York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and Statistics, Springer, 2005 Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006 A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013

Courses				
Title		Тур	Hrs/wk	СР
Ship Structural Design (L0412)		Lecture	2	3
Ship Structural Design (L0415)		Recitation Section (small)	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students can reproduce design and sizing as	well as fabrication of the different areas of ship	structures and o	f different ship typ
	(incl. detail design); they can describe calcula	tion models for complex structures.		
Skills		nents for different ship types and areas of the	hull, to define d	esign criteria for
	components, to select suitable calculation mo		hull, to define d	esign criteria for t
Personal Competence	components, to select suitable calculation mo	dels and to assess the chosen structure		esign criteria for t
Personal Competence	components, to select suitable calculation mo			esign criteria for t
Personal Competence Social Competence	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent	dels and to assess the chosen structure	vely in a group.	
Personal Competence Social Competence	components, to select suitable calculation mo	odels and to assess the chosen structure	vely in a group.	
Personal Competence Social Competence Autonomy	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent	odels and to assess the chosen structure ral design and discuss their decisions constructions constructions areas of the ship hull a	vely in a group.	
Personal Competence Social Competence Autonomy	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods.	odels and to assess the chosen structure ral design and discuss their decisions constructions constructions areas of the ship hull a	vely in a group.	
Personal Competence Social Competence Autonomy Workload in Hours	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods.	odels and to assess the chosen structure ral design and discuss their decisions constructions constructions areas of the ship hull a	vely in a group.	
Personal Competence Social Competence Autonomy Workload in Hours Credit points	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods.	odels and to assess the chosen structure ral design and discuss their decisions constructions constructions areas of the ship hull a	vely in a group.	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods.	odels and to assess the chosen structure ral design and discuss their decisions constructions constructions areas of the ship hull a	vely in a group.	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time in I 9 None Written exam 3 hours	adels and to assess the chosen structure ral design and discuss their decisions construction the ship hull areas of the ship hull areas ecture 98	vely in a group. nd different ship	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	components, to select suitable calculation mo Students are capable to present their structur Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time in I 9 None Written exam 3 hours	adels and to assess the chosen structure ral design and discuss their decisions construction the ship hull areas of the ship hull areas ecture 98 m, 7 semester): Specialisation Naval Architecture	vely in a group. nd different ship	

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

Course L0415: Ship Structural Design	
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rüdiger Ulrich Franz von Bock und Polach
Language	DE
Cycle	SoSe
Content	Chapters:
	 Bulkheads and tanks Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength Safety factors and reliability of structures
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

Course L1123: Welding Tech	nology
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	
Cycle	
Content	 phase transitions, phase diagrams and thermal activated processes
	- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams
	- properties of weldable carbon and fine grained steels
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
	- structure and properties of non-ferrite metals (aluminum, titanium)
	- NDT/DT Methods for materials and welds
	- gas fusion welding, fundamentals of electric arc welding technologies
	- structure and influence parameters for the welded joint
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding
	- resistance welding/ polymer welding/ hybrid-welding
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Ship Structural De	sign (10411)	Lecture	2	2
		Recitation Section (small)	1	2
Fundamentals of Ship Structural Design (L0413) Fundamentals of Ship Structural Analysis (L0410)		Lecture	2	2
Fundamentals of Ship Structural Analysis (L0410) Lecture 2 Fundamentals of Ship Structural Analysis (L0414) Recitation Section (small) 1		2		
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
5	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
	gg			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
-	Students can reproduce the basic contents of the str	ructural behaviour of ship structures: the	v can explain the	theory and metho
	for the calculation of deformations and stresses in be		,	
	Furthermore, they can reproduce the basis contents	s of codes (rules), materials, semi-finish	ed products, join	ing and principles
	structural design of components in the ship structure	2.		
Skills	Students are capable of applying the methods and	d tools for the calculation of linear defe	ormations and st	resses in the abo
	mentioned structures; they can choose calculation m			
	······································			
	Furthermore, they are capable to apply the method	s of drawing and sizing the ship structur	e; they can seled	ct suitable materia
	semi-finished products and joints.			
Personal Competence				
Social Competence	The students are able to communicate and cooper	ate in a professional environment in the	e shipbuilding an	d component supp
	industry.			
Autonomy	The students are capable to independently idealize	real chip structures and to select suitab	la mathada far	analysis of boom li
Autonomy				
	structures; they are capable to assess the results of	structural analyses.		
	Furthermore, they are capable to assess drawing	gs of complex ship structures and to	design ship st	ructures for vario
	requirements and boundary conditions.			
Workload in Hours	Independent Study Time 156, Study Time in Lecture	84		
Credit points	8	-		
Course achievement	None			
Examination				
Examination				
Examination duration and	3 hours			
scale				
Assignment for the	General Engineering Science (German program, 7 se		e: Compulsory	
Following Curricula	Orientation Studies: Core Qualification: Elective Com	pulsory		
	Naval Architecture: Core Qualification: Compulsory			

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

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

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

ourse L0414: Fundamentals of Ship Structural Analysis		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Contents:	
	1. Introduction	
	2. Finite element method (f.e. method) by the example of trussworks	
	3. Force methods for frameworks	
	4. F.e. method for frameworks	
	5. Shear and torsion in thin-walled beams	
	6. Beams subjected to longitudinal forces	
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente	

Courses				
Title		Тур	Hrs/wk	СР
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Mechanics			
Knowledge	Fluid Dynamics for Naval Architects			
	Hydrostratics			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for re			
	phenomena and their practical applications to hullform	-		
	of the course. Furthermore, environmental additional			
	their application to full scale ships. This hold also for		-	
	Main Focus is how hull forms can be optimized for min		i. The following to	opics are dealt with
	- Stillwater/added resistance, Wave resistance, Mini	mization of wave resistance, numeric	al prediction me	thods, friction law
laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and res		resistance, Froude		
	resistance law,form factor method, thrust deduction,	wake, model scaling laws, resistance t	ests, free running	g propeller tests a
	propeller basics, propulsion tests, full scale speed po	ower predictions, additional resistances	s (wind, steering,	current, sea state
	EEDI, speed trials, contractual matters concerning spe	ed/power, bunker claims		
Skills	The student shall learn to design competitve hull form	as with respect to fuel consumption by	applying numreic	al techniques and
U.M.B	evaluate these hulls by several progosis methods.			
	minimize the required power including environmental			
Personal Competence				
	The student learns to prepare technical matters in suc		-	
Autonomy	The student learns to prepare technical matters in suc	h a way that he can compte with his bu	illding suvervisior	i team.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	nester): Specialisation Naval Architectur	e: Compulsory	
Following Curricula	Naval Architecture: Core Qualification: Compulsory			
Course L1265: Resistance ar	nd Propulsion			
Тур	Lecture			
Hrc/wk	2			

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 an	ourse L1266: Resistance and Propulsion	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	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	

Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (LC		Lecture	2	3
Computational Fluid Dynamics I (LC		Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
	Students should have sound knowledge of engineer			
Knowledge	with the foundations of partial/ordinary differential equations. They should also be familiar with engineering fluid mechanics at thermodynamics.			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students will have the required combined know principles of thermo-/fluid engineering into disc (potential theory) ansatz functions. They are fan approximation concepts for investigating couple explain the motivation for applying them. Student numerical algorithms dedicated to the solution of t to predict thermofluid dynamic fields, in particular	rete algorithms on the basis of local (fin niliar with the similarities and differences d systems of non-linear, convective part is have the required background knowledg thermofluid dynamic PDEs. They are famili	nite differences/ between differential e ial differential e e to develop, coo	volumes) and glo nt discretisation a quations (PDE), a le, explain and ap
Skills	The students are able choose and apply appropriate numerical procedures that integrate the governing thermofluid dynamic PDE in space and time. They can apply/optimise numerical analysis concepts to/for fluid dynamic applications. They can con- computational algorithms in a structured way, apply these codes for parameter investigations and supplement interfaces to extract simulation data for an engineering analysis.			
Personal Competence Social Competence	e The students are able to discuss problems, present the results of their own analysis, and jointly develop, implement and re		ement and report	
Autonomy	solution strategies that address given technical reference problems. The students can independently analyse numerical methods to solving fluid engineering problems. They are able to critica analyse own results as well as external data with regards to the plausibility and reliability.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	2h			
Assignment for the Following Curricula	General Engineering Science (German program, Engineering: Elective Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, Elective Compulsory Energy Systems: Technical Complementary Course Mechanical Engineering: Specialisation Energy Sys	semester): Specialisation Naval Architectur 7 semester): Specialisation Mechanical e Core Studies: Elective Compulsory	e: Compulsory	-
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering	/		

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

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

Courses				
Title		Тур	Hrs/wk	СР
ihip Design (L1262)		Lecture	2	3
hip Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
-	None			
Recommended Previous Knowledge	Fluid Dynamics for Naval Architects, ResistaResistance and Propulsion, Hydrostatics	ance and Propulsion		
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
	The lecture starts with an overview about the im Ship Designs are thoroughly discussed. Typical bu main parameters of a ship are introduced and tl influence of alternated main parameters on the tr lecture, the design changes are dealt with by s systems properly so that the relavent technical co The lecture continues with an introduction into th contract. Further, methods are introduced to gen during the different design stages. In detail, the for - Structure of a building specification - Determination of Light Ship Weight and Deadwei Components - Design of main section and hull form - Design of fatbody 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	Iding contracts and the related technical ris heir influence on the competitiveness of a batal performance of a ship design and the simple models or formulae. The student inclusions can be drawn. The different phases of design project, from erate bulding specfication relevant information llowing topics are adressed:	sk are introduced design. The lect consecutive proc shall further lear the initial design	. The most importa ture focusses on t ess elements. In t n to model compl n phase to a buildi
	 Relevant rules and regulations The student is made familiar with the basic desistudent shall be able to carry out a concept desig the Marine Environment. The lecture deals with the of a ship design with respect to fulfillment proced relevant methods to determine and judge uopn the 	n based on a vessel of comparison fulfilling ne basic design methods to determine the ures of the contract values. Based on the l	g typical contract fundamantal tec ecture "Principle	requirements with hnical characterist
Personal Competence				
Social Competence	The students learns to prepare technical matte	ers in such a way the he can persuade	his potantial c	ustomer against l
Autonomy	competitors. The students learns to prepare technical matt competitors.	ers in such a way the he can persuade	his potantial c	ustomer against l
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	180 min			
	General Engineering Science (German program, 7 Naval Architecture: Core Qualification: Compulson		e: Compulsory	
.				
Course L1262: Ship Design				
Тур	Lecture			
Hrs/wk	2			

Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1264: Ship Design	ourse L1264: Ship Design	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content		
Literature		

	Thesis
Module M-001: Bache	lor Thesis
Module M-001. Bache	
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	According to General Regulations §21 (1):
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course
	of study (facts, theories, and methods).
	• On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue
	opening up and establishing links with extended specialized expertise.
	 The students are able to outline the state of research on a selected issue in their subject area.
Skills	
	 The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solv subject-related problems.
	 With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions of
	technical issues, and develop solutions.
	• The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence	
Social Competence	• Both in writing and grally the students can outline a scientific issue for an expert audience assurately understandably a
	 Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably an in a structured way.
	 The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the
	addressees. In doing so they can uphold their own assessments and viewpoints convincingly.
Autonomy	. The students are canable of structuring an automica work process is terms of time and of dealing with an issue within
	 The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within specified time frame.
	 The students are able to identify, open up, and connect knowledge and material necessary for working on a scientif
	problem.
	• The students can apply the essential techniques of scientific work to research of their own.
Werkland in Herre	Jadaman dank Chudu Tinga 260. Chudu Tinga in Lankura 0.
Credit points	Independent Study Time 360, Study Time in Lecture 0
Course achievement	
Examination	Thesis
	According to General Regulations
scale	
	General Engineering Science (German program): Thesis: Compulsory
-	
	Civil- and Environmental Engineering: Thesis: Compulsory
	Bioprocess Engineering: Thesis: Compulsory
	Chemical and Bioprocess Engineering: Thesis: Compulsory
	Computer Science: Thesis: Compulsory
	Data Science: Thesis: Compulsory
	Digital Mechanical Engineering: Thesis: Compulsory
	Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory
	Engineering Science: Thesis: Compulsory
	General Engineering Science (English program): Thesis: Compulsory
	General Engineering Science (English program, 7 semester): Thesis: Compulsory
	Green Technologies: Energy, Water, Climate: Thesis: Compulsory
	Computer Science in Engineering: Thesis: Compulsory
	Integrated Building Technology: Thesis: Compulsory
	Logistics and Mobility: Thesis: Compulsory
	Mechanical Engineering: Thesis: Compulsory
	Mechatronics: Thesis: Compulsory
	Naval Architecture: Thesis: Compulsory
	Technomathematics: Thesis: Compulsory
	Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory

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