

Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2017

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Program description

Content

The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study (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 M0577: Nontechnical Complementary Courses for Bachelors Module Responsible Dagmar Richter **Admission Requirements** None **Recommended Previous** None Knowledge Educational Objectives | After taking part successfully, students have reached the following learning results **Professional Competence**

Knowledge The Non-technical Academic Programms (NTA)

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

The Learning Architecture

consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses.

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

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

Teaching and Learning Arrangements

provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.

Fields of Teaching

are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migration studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-

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

The Competence Level

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

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

Specialized Competence (Knowledge)

Students can

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

Professional Competence (Skills)

In selected sub-areas students can

- apply basic methods of the said scientific disciplines,
- auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,
- to handle simple questions in aforementioned scientific disciplines in a sucsessful manner.
- justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.

Personal Competence

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

Courses

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

Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields				
Courses				
Title		Тур	Hrs/wk	СР
, ,	ent Networks and Electromagnetic Fields (L0675)	Lecture	3	5
	ent Networks and Electromagnetic Fields (L0676)	Recitation Section (small)	2	1
Module Responsible	Prof. Manfred Kasper			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	zweistündig			
scale				
Assignment for the	General Engineering Science (German program): Core C	ualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 seme	ster): Core Qualification: Compulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	Computational Science and Engineering: Core Qualificat	ion: Compulsory		
	Mechatronics: Core Qualification: Compulsory			

Course L0675: Electrical Eng	ineering I: Direct Current Networks and Electromagnetic Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Manfred Kasper
Language	DE
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
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Manfred Kasper
Language	DE
Cycle	WiSe
Content	
Literature	Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013 Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010

Module M0889: Mech	anics I (Statics)			
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	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Solid school knowledge in mathematics and physics			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in me	chanical contexts:		
	explain important steps in model design;	,		
	 present technical knowledge in stereostatics. 			
Skills	The students can			
	 explain the important elements of mathematical 	cical / mechanical analysis and model for	mation, and appl	y it to the context of
	their own problems;			
	 apply basic statical methods to engineering p 	roblems;		
	estimate the reach and boundaries of statical	methods and extend them to be applica	ble to wider probl	em sets.
Personal Competence				
Social Competence	The students can work in groups and support each o	other to overcome difficulties.		
Autonomy	Students are capable of determining their own strer	igths and weaknesses and to organize th	eir time and learn	ing based on those.
Workload in Hours	Independent Study Time 110, Study Time in Lecture	· 70		
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Co	re Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 se	emester): Core Qualification: Compulsory		
	Civil- and Environmental Engineering: Core Qualifica	ition: Compulsory		
	Mechanical Engineering: Core Qualification: Compul	sory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			

Course L1001: Mechanics I (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	Forces and equilibrium
	Constraints and reactions
	Frames
	Center of mass
	Friction
	Internal forces and moments for beams
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Course L1002: Mechanics I (Statics)	
Тур	Recitation Section (small)
Hrs/wk	2
СР	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
СР	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 Analysis I (L1010)		Typ Lecture	Hrs/wk	CP 2
Analysis I (L1012)		Recitation Section (small)	1	1
Analysis I (L1013)		Recitation Section (large)	1	1
Linear Algebra I (L0912)		Lecture	2	2
Linear Algebra I (L0913)		Recitation Section (small)	1	1
Linear Algebra I (L0914)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
	None			
Recommended Previous	School mathematics			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can name the basic concepts in an	alvsis and linear algebra. They are able	e to explain the	em using appropriate
	examples.	,, <u>-</u>		
	Students can discuss logical connections betw	een these concepts. They are capable	of illustrating th	lese connections with
	the help of examples.		_	
	They know proof strategies and can reproduce	them.		
Skills				
	Students can model problems in analysis and		pts studied in t	his course. Moreover,
	they are capable of solving them by applying e		and the sale of the sale	
	Students are able to discover and verify further Torio given problem, the students are devel			
	For a given problem, the students can devel	op and execute a suitable approach, ar	nd are able to d	critically evaluate the
	results.			
Personal Competence				
Social Competence	Students are able to work together in teams. T	hey are capable to use mathematics as a	a common langu	age.
	In doing so, they can communicate new conce	pts according to the needs of their coop	erating partners	. Moreover, they can
	design examples to check and deepen the und	erstanding of their peers.		
Autonomy	• Students are capable of shocking their under	tanding of compley concents on their or	un Thou can cr	osify open guestions
	 Students are capable of checking their unders precisely and know where to get help in solvin 		wii. Tiley call sp	becity open questions
	Students have developed sufficient persistence		in a goal-orier	ated manner on hard
	problems.	te to be able to work for longer periods	s iii a goai-onei	ited manner on nard
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points	8			
Examination	Written exam			
Examination duration and	60 min (Analysis I) + 60 min (Linear Algebra I)			
scale				
Assignment for the	General Engineering Science (German program): Core	e Qualification: Compulsory		
Following Curricula				
	Civil- and Environmental Engineering: Core Qualificat	ion: Compulsory		
	Bioprocess Engineering: Core Qualification: Compulso	pry		
	Electrical Engineering: Core Qualification: Compulsor	/		
	Energy and Environmental Engineering: Core Qualific	ation: Compulsory		
	Computational Science and Engineering: Core Qualification	cation: Compulsory		
	Logistics and Mobility: Core Qualification: Compulsory	1		
	Mechanical Engineering: Core Qualification: Compulse	ory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			

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

Course L1012: Analysis I	
Тур	Recitation Section (small)
Hrs/wk	1
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	
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 L0912: Linear Algebra	a I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants
Literature	 T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994

Course L0913: Linear Algebra	al
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants
Literature	 T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994

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

Module M1315: Physic	cs for Engineers (AIW)			
Courses				
Title		Тур	Hrs/wk	СР
Physics for Engineers (L0367)		Lecture	2	3
Physics for Engineers (Problem Solv	ving Course) (L0368)	Recitation Section (small)	1	1
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous	Calculus and linear algebra on high school level			
Knowledge	Physics on high school level			
	Physics on high school level			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics so	uch as in the areas of mechanics	, oscillations,	
	waves, and optics.			
	Students can relate physics topics to technical problems.			
Skille	Students can describe physical problems mathematically a	nd calva cuch problems within	the framewor	d of their acquired
SKIIIS	mathematical expertise.	nd solve such problems within	i tile irailiewoi	k of their acquired
	mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups.	They can present their results ef	fectively within	the framework of the
	problem solving courses.			
A. d	Charles have been been been been been been been be			
Autonomy	Students are capable to extract relevant information from the	•		
	the lecture. They can reflect their acquired level of expertis	·		sures such as exam
	typical exam questions. Students are able to connect their kno	wiedge with that acquired from	otner lectures.	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Credit points	4			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): C	Core Qualification: Compulsory		
Following Curricula				

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

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

Module M0687: Chem	istry			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry I (L0460)		Lecture	2	2
Chemistry I (L0475)		Recitation Section (large)	1	1
Chemistry II (L0465)		Lecture	2	2
Chemistry II (L0476)		Recitation Section (large)	1	1
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
	The students are able to name and to describe basic princ table, chemical bonds), physical chemistry (aggregate chemistry (acid/base, pH-value, salts, solubility, redox, marken carbonyl compounds, aromates, reaction mechanisms, ne explain basic chemical terms.	states, separating processes, tetals) and organic chemistry (aliph	hermodynamics, atic hydrocarbor	kinetics), inorganicus, functional groups,
Skills	After successful completion of this module students are ab they are capable of explaining, choosing and applying spe-			ounds. On this basis,
Personal Competence				
Social Competence	Students are able to take part in discussions on chemical contribute to those discussion by their own statements.	ssues and problems as a member	of an interdiscipli	inary team. They can
Autonomy	After successful completion of this module students are approaches with arguments. They can also document their	·	ndependently by	defending proposed
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	<u> </u>		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program): Core Qua	lification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 semeste	er): Core Qualification: Compulsory		
	Civil- and Environmental Engineering: Core Qualification: C	ompulsory		
	Technomathematics: Specialisation III. Engineering Science	e: Elective Compulsory		

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

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

Course L04	65: Chemistry II	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload	Independent Study Time 32, Study Time in Lecture 28	
in Hours		
Lecturer	Dr. Christoph Wutz	
Language	DE	
Cycle	WiSe	
Content	- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,	
	- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars	
	- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction	
	- Practical apllications and examples	
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure	
	- Kickelbick: Chemie für Ingenieure (Pearson)	
	- Schmuck: Basisbuch Organische Chemie (Pearson)	

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

Module M1121: Progr	amming in C			
Courses				
Title		Тур	Hrs/wk	СР
Programming in C (L0083)		Lecture	1	1
Programming in C (L1488)		Practical Course	1	1
Module Responsible	Prof. Siegfried Rump			
Admission Requirements	None			
Recommended Previous	Elementary PC handling skills			
Knowledge	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	The short state because he has state a basis and the state of Con-		bank and	
Knowleage	The students know by heart the basic syntax of C p	rogramming as well as its meaning, ir	itent and	
	purpose.			
	They know the fundamental components and princi	ples of elementary procedural progra	mming	
	based on C programming and can explain them:			
	basic data types (integers, floating point numbers)	s, characters)		
	advanced data types (pointers, arrays, strings, co			
	• operators (arithmetical operations, logical operati	ons, bit operations)		
	• control flow (choice, loops, jumps, conditional con	npilation)		
	functions and macros			
	important standard libraries and functions			
	• recursion			
	linked lists			
	The students are prepared for continuing programn	ning lectures like object oriented prog	ramming in C++.	
Skills	The students know how to use an integrated develo	opment environment for C programmi	ng on a PC	
	so that they can write, store, compile and execute	C programs on it.		
	Using their knowledge they are able to read and un	derstand given C Programs.		
	They can solve simple algorithmic problems on their	ir own and can model and program the	eir solutions	
	in C language.			
	The students are able to solve selected exercises fr	om other areas of their study like mat	hematics,	
	mechanics, electrical engineering or physics with the	ne aid of small C programs/-projects n	umerically.	
Personal Competence				
	The students are able to work in small teams to sol	ve given weekly tasks, to identify and	analyze	
<i>p</i> - 1.100	programming errors and to present their results.	, , , , , , , , , , , , , , , , , , , ,	-	
	They are able to explain simple phenomena to each	o other directly at the PC		
Autonomy	The students prepare themselves using the given to	eaching material and solve the given		
	programming exercises on their own.			
	Additionally, they write small C programs to unders	tand and check addressed issues and	also to	
	gain a certain programming experience.			
	For details beyond the scope of the lecture the stuc	lents inform themselves using the star	ted	
	literature and / or by supplementary own research.	icines inform chemiserves using the Sta	-cu	
	The state of the s			
Workload in Hours	Independent Study Time 32, Study Time in Lecture	28		
Credit points	2			
Examination	Written elaboration			
Examination duration and	1-2 coding tasks weekly			
scale				
Assignment for the	General Engineering Science (German program): Co	ore Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 s		sory	
	General Engineering Science (English program): Co			
	General Engineering Science (English program, 7 se	emester): Core Qualification: Compuls	ory	

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

Course L1488: Programming in C	
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0547: Electi	rical Engineering II: Alternating Curre	nt Networks and Basic De	vices	
Courses				
Title		Тур	Hrs/wk	СР
	g Current Networks and Basic Devices (L0178)	Lecture	3	5
	g Current Networks and Basic Devices (L0179)	Recitation Section (small)	2	1
Module Responsible				
Admission Requirements				
Recommended Previous	Electrical Engineering I			
Knowledge	Mathematics I			
	Direct current networks, complex numbers			
	bliect current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence	Anter taking part succession, state have reached to	ne renewing rearrang results		
· ·	Students are able to reproduce and explain fundame	ental theories, principles, and methods	related to the	theory of alternating
J. Company of the com	currents. They can describe networks of linear elemer			
	an overview of applications for the theory of alternat	ing currents in the area of electrical	engineering. Stu	dents are capable of
	explaining the behavior of fundamental passive and ac	tive devices as well as their impact on	simple circuits.	
Skills	Students are capable of calculating parameters within	•	-	•
	notation for voltages and currents. They can apprai			
	alternating currents. Students are able to analyze s	,		3
	quantitatively and dimension elements by means of electrical power supply (transformer, transmission line		-	
	dimension their main features.	e, compensation of reactive power, me	respirade dystern,	, and are quanted to
Personal Competence				
Social Competence	Students are able to work together on subject related	tasks in small groups. They are able to	present their re	sults effectively (e.g.
	during a week of project work).			
Autonomy	Students are capable to gather necessary information			
	the lecture. They are able to continually reflect their ki	* *		
	tests and exercises that are related to the exam. Bas learning process. They are able to draw connections			
	lectures (e.g. Electrical Engineering I, Linear Algebra, a		tilis lecture und	the content of other
	,			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70)		
Credit points	6			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program): Core	Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 sem	ester): Core Qualification: Compulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	Computational Science and Engineering: Core Qualifica	ation: Compulsory		
	Mechatronics: Core Qualification: Compulsory			

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

Course L0179: Electrical Engineering II: Alternating Current Networks and Basic Devices		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	ndependent Study Time 2, Study Time in Lecture 28	
	Prof. Christian Becker	
Language		
Cycle		
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)	
ı		

Module M0594: Funda	amentals of Mechanical Engineering	Design		
Courses				
Title Fundamentals of Mechanical Engine Fundamentals of Mechanical Engine		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge about mechanics and product Internship (Stage I Practical)	ion engineering		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
Skills	explain basic working principles and functions explain requirements, selection criteria, applic the background of dimensioning calculations. After passing the module, students are able to:		es of basic machin	e elements, indicate
	accomplish dimensioning calculations of covere transfer knowledge learned in the module to re recognize the content of technical drawings an technically evaluate basic designs.	ew requirements and tasks (problem s	olving skills),	
Personal Competence Social Competence Autonomy	Students are able to discuss technical informat Students are able to independently deepen the Students are able to acquire additional knowled recordings of the lectures.	ir acquired knowledge in exercises.		. by using the video
	recordings of the fectures.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the	General Engineering Science (German program): Core	Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 ser	nester): Core Qualification: Compulsor	у	
	Energy and Environmental Engineering: Core Qualifica	ation: Compulsory		
	General Engineering Science (English program): Core			
	Logistics and Mobility: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulso	ory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Sc Technomathematics: Core Qualification: Elective Com			

Course L0258: Fundamentals	of Mechanical Engineering Design
Тур	Lecture
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	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. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag, Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

Course L0259: Fundamentals of 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

Module M0696: Mech	anics II: Mechanics of Materials			
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	NN			
Admission Requirements	None			
Recommended Previous	Mechanics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	-			
Knowledae	The students name the fundamental concepts and la	ws of statics such as stresses, strains, Ho	ooke's linear law.	
-	The students apply the mathematical/mechanical an			
		3		
	The students apply the fundamental methods of elas	to statics to simply engineering problems	5.	
	The students estimate the validity and limitations of	the introduced methods.		
	,,			
Personal Competence				
Social Competence				
Autonomy				
	Indonesia de Chiedu Tines OC Chiedu Tines in Lechure O	4		
	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points				
Examination				
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Cor	, ,		
Following Curricula	General Engineering Science (German program, 7 se			
	Civil- and Environmental Engineering: Core Qualification			
	Mechanical Engineering: Core Qualification: Compuls	ory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			

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. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	stresses and strains
	Hooke's law
	tension and compression
	torsion
	bending
	stability
	buckling
	energy methods
Literature	K. Magnus, H.H. Müller -Slany, Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2005)
	D. Gross, W. Hauger, W. Schnell, J. Schröder, Technische Mechanik 1&2. 8. Auflage, Springer
	(2004).
	R.C. Hibbeler, Technische Mechanik
	1&2. Pearson (2005)

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

Course L1691: Mechanics II	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. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0671: Techn	ical Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics I (L043)	7)	Lecture	2	4
Technical Thermodynamics I (L043)		Recitation Section (large)	1	1
Technical Thermodynamics I (L044)		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics and Mechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	he following learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamic	cs. They know the relation of the kind	ds of energy acc	ording to 1 st law of
	distinguish between state variables and process variaenthalpy, entropy and also the meaning of exergy at related diagram. They know the physical difference be state. They know the meaning of a fundamental state of	nd anergy. They are able to draw the etween an ideal and a real gas and are	e Carnot cycle in e able to use the	a Thermodynamics related equations of
Skills	Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and de	evelop an approach.		
Autonomy	Students are able to define independently tasks, to get	t new knowledge from existing knowle	dge as well as to	find ways to use the
	knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6	,		
	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Core	Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 seme	ester): Core Qualification: Compulsory		
	Bioprocess Engineering: Core Qualification: Compulsory	/		
	Energy and Environmental Engineering: Core Qualificat	ion: Compulsory		
	General Engineering Science (English program): Core C	Qualification: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Core Qualification: Compulsory		
	Computational Science and Engineering: Specialisation		ulsory	
	Mechanical Engineering: Core Qualification: Compulsor	у		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	51 ··· 6		
	Technomathematics: Specialisation III. Engineering Scie	ence: Elective Compulsory		
	Process Engineering: Core Qualification: Compulsory			

Course L0437: Technical The	rmodynamics I
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	SoSe
Content	1. Introduction
	2. Fundamental terms
	Thermal Equilibrium and temperature
	3.1 Thermal equation of state
	4. First law
	4.1 Heat and work
	4.2 First law for closed systems
	4.3 First law for open systems
	4.4 Examples
	5. Equations of state and changes of state
	5.1 Changes of state
	5.2 Cycle processes 6. Second law
	6.1 Carnot process
	6.2 Entropy
	6.3 Examples 6.4 Exergy
	7. Thermodynamic properties of pure fluids
	7. 1 Fundamental equations of Thermodynamics
	7.2 Thermodynamic potentials
	7.3 Calorific state variables for arbritary fluids
	7.4 state equations (van der Waals u.a.)
	7.4 state equations (van der waais a.a.)
Literature	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

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

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

Module M0851: Matho	ematics II			
Courses				
Title Analysis II (L1025)		Typ Lecture	Hrs/wk	CP 2
Analysis II (L1026) Analysis II (L1027) Linear Algebra II (L0915)		Recitation Section (large) Recitation Section (small) Lecture	1 1 2	1 1 2
Linear Algebra II (L0916) Linear Algebra II (L0917)		Recitation Section (small) Recitation Section (large)	1 1	1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence Knowledge	Students can name further concepts in ana examples. Students can discuss logical connections between the help of examples. They know proof strategies and can reproduce	veen these concepts. They are capable o		
Skills	 Students can model problems in analysis and they are capable of solving them by applying Students are able to discover and verify furthe For a given problem, the students can deve results. 	established methods. er logical connections between the concep	ts studied in the	e course.
Personal Competence Social Competence	 Students are able to work together in teams. In doing so, they can communicate new concudesign examples to check and deepen the unconcurrence. 	epts according to the needs of their coope		-
Autonomy	 Students are capable of checking their under precisely and know where to get help in solvir Students have developed sufficient persisten problems. 	g them.		
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points				
Examination				
Examination duration and scale	60 min (Analysis II) + 60 min (Linear Algebra II)			
	General Engineering Science (German program): Cor	e Qualification: Compulsorv		
Following Curricula		• •		
	Civil- and Environmental Engineering: Core Qualificat	cion: Compulsory		
	Bioprocess Engineering: Core Qualification: Compuls			
	Electrical Engineering: Core Qualification: Compulsor	•		
	Energy and Environmental Engineering: Core Qualific Computational Science and Engineering: Core Qualific			
	Logistics and Mobility: Core Qualification: Compulsor			
	Mechanical Engineering: Core Qualification: Compuls			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			

Course L1025: Analysis II	
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	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	Course L1026: Analysis II	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1027: Analysis II	
Тур	Recitation Section (small)
Hrs/wk	1
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 L0915: Linear Algebra	a II		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner		
Language	DE		
Cycle	SoSe		
Content	 linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: QR-decomposition, normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition system of linear differential equations 		
Literature	 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 		

Course L0916: Linear Algebra II			
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner		
Language	DE		
Cycle	SoSe		
Content	 linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: QR-decomposition, normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition system of linear differential equations 		
Literature	 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 		

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

Module M0688: Techr	nical Thermodynamics II			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics II (L0449)		Lecture	2	4
Technical Thermodynamics II (L0450)		Recitation Section (large)	1	1
Technical Thermodynamics II (L045	1)	Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics, Mechanics and	Technical Thermodynamics I		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledae	Students are familiar with different cycle processes like	e loule, Otto, Diesel, Stirling, Seiliger a	nd Clausius-Rank	ine. They are able to
	derive energetic and exergetic efficiencies and know			
	clockwise and clockwise cycles (heat-power cycle, cool			
	draw the different cycles in Thermodynamics related			
	processes and are able to perform simple combustion			
	know the definition of the speed of sound and know abo		3	,
	•			
Skills	Students are able to use thermodynamic laws for the o	design of technical processes. Especial	lly they are able	to formulate energy
Skiiis				
	exergy- and entropy balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from a tank. They are able to transform a verbal formulated message into an abstract formal			
	procedure.	able to transform a verbal formatate	ca message me	o an abstract forme
Personal Competence				
Social Competence	The students are able to discuss in small groups and de	evelop an approach.		
Autonomy	Students are able to define independently tasks, to get	new knowledge from existing knowled	dae as well as to	find wave to use the
Autonomy	knowledge in practice.	. Hew knowledge from existing knowled	uge as well as to	illia ways to use the
	knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	;		
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Core	Qualification: Compulsory		
Following Curricula				
-	Bioprocess Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualificat			
	General Engineering Science (English program): Core Q			
	General Engineering Science (English program, 7 seme	· ·		
	Computational Science and Engineering: Specialisation		llsory	
	Mechanical Engineering: Core Qualification: Compulsor		-	
	Mechatronics: Core Qualification: Compulsory	-		
	Technomathematics: Specialisation III. Engineering Science	ence: Elective Compulsory		
	Process Engineering: Core Qualification: Compulsory	•••••		
	3 3 4			

Course L0449: Technical Thermodynamics II		
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Schmitz	
Language	DE	
Cycle	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	

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

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

Module M0959: Mech	anics III (Hydrostatics, Kinema	tics, Kinetics I)		
Courses				
Title		Тур	Hrs/wk	СР
Mechanics III (Hydrostatics, Kinematics, Kinetics I) (L1134)		Lecture	3	3
Mechanics III (Hydrostatics, Kinema		Recitation Section (small)	2	2
Mechanics III (Hydrostatics, Kinema		Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Mathematics I, II, Mechanics I (Statics)			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used	d in mechanical contexts;		
	 explain important steps in model design 	gn;		
	present technical knowledge in stereo	statics.		
Skills	The students can			
	 explain the important elements of ma their own problems; 	thematical / mechanical analysis and model fo	ormation, and appl	y it to the context of
	 apply basic hydrostatical, kinematic ar 	nd kinetic methods to engineering problems;		
	estimate the reach and boundaries of	statical methods and extend them to be applic	able to wider probl	em 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	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 96, Study Time in Le	ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German progra	am): Core Qualification: Compulsory		
Following Curricula	General Engineering Science (German progra	am, 7 semester): Core Qualification: Compulsor	у	
	Mechanical Engineering: Core Qualification: 0	Compulsory		
	Mechatronics: Core Qualification: Compulsory	/		
	Naval Architecture: Core Qualification: Comp	ulsory		
	Technomathematics: Specialisation III. Engine	eering Science: Elective Compulsory		

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

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

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

Module M0853: Mathe	ematics III			
Courses				
Title		Тур	Hrs/wk	СР
Analysis III (L1028)		Lecture	2	2
Analysis III (L1029)		Recitation Section (small)	1 1	1
Analysis III (L1030) Differential Equations 1 (Ordinary Differential Equations) (L1031)		Recitation Section (large) Lecture	2	2
Differential Equations 1 (Ordinary E		Recitation Section (small)	1	1
Differential Equations 1 (Ordinary E		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements				
Recommended Previous	Mathematics I + II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in the area c	f analysis and differential equations	. They are able	to explain them using
	appropriate examples.			
	Students can discuss logical connections between the students can discuss logical connections.	these concepts. They are capable	of illustrating th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce then 	1.		
G1 '''				
Skills	Students can model problems in the area of analys	s and differential equations with the	e help of the cor	ncepts studied in this
	course. Moreover, they are capable of solving them			
	Students are able to discover and verify further logi	cal connections between the concep	ots studied in the	e course.
	For a given problem, the students can develop ar	nd execute a suitable approach, ar	nd are able to c	ritically evaluate the
	results.			-
Personal Competence				
Social Competence				
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	 Students are able to work together in teams. They a 	re capable to use mathematics as a	common langu	age.
	 In doing so, they can communicate new concepts a 	ccording to the needs of their coop	erating partners	. Moreover, they can
	design examples to check and deepen the understa	nding of their peers.		
Autonomy	Students are capable of checking their understand	ng of compley concents on their or	wn They can sn	ecify open guestions
	precisely and know where to get help in solving the		wii. Tiley call sp	ecity open questions
	Students have developed sufficient persistence to		in a goal orion	tod mannor on hard
	problems.	be able to work for longer periods	s III a goal-orieli	teu manner on naru
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	, , ,			
	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program): Core Qua	lification: Compulsory		
Following Curricula	General Engineering Science (German program, 7 semeste	' '		
	Civil- and Environmental Engineering: Core Qualification: C			
	Bioprocess Engineering: Core Qualification: Compulsory	, ,		
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification	Compulsory		
	General Engineering Science (English program): Core Qual	ification: Compulsory		
	General Engineering Science (English program, 7 semeste	• •		
	Computational Science and Engineering: Core Qualification			
	Computational Science and Engineering: Core Qualification			
	Mechanical Engineering: Core Qualification: Compulsory	•		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			
	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3			

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	
Libraria na	Differential calculus for several variables Mean value theorems and Taylor's theorem Maximum and minimum values Implicit functions Minimization under equality constraints Newton's method for multiple variables Double integrals over general regions Line and surface integrals Theorems of Gauß and Stokes	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

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

Course L1030: Analysis III	
Тур	Recitation Section (large)
Hrs/wk	1
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)		
	Lecture	
Hrs/wk		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
	Dozenten des Fachbereiches Mathematik der UHH	
Language		
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-hamburq.de/teachinq/export/tuhh/index.html	
	Tittp://www.maur.um-namburg.ue/teaching/export/tum/muex.html	

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

ourse L1033: Differential Equations 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	See interlocking course
Literature	See interlocking course

Module M1273: Adva	nced Internship AIW/ GES
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Prof. Robert Seifried
Admission Requirements	None
Recommended Previous	150 Creditpoints in General Engineering Science
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students of the different specialisations get experiences in typical scope of duties of engineers, who are working in a development
	division, planning division or in the management of a company. In the framework of this environment the knowledge from
	university can used a first time for real engineering tasks.
Skills	Students of the different specialisations should be integrated in typical day's work. By this they are learning typical tasks and
SKIIIS	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-workers in a company and to understand the language of engineers.
Autonomy	Students can finish own tasks.
Workload in Hours	Independent Study Time 540, Study Time in Lecture 0
Credit points	18
Examination	Written elaboration (accord. to Internship Regulations)
Examination duration and	see Internship Regulations
scale	
9	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory
Following Curricula	Engineering Science: Core Qualification: Compulsory
	General Engineering Science (English program, 7 semester): Core Qualification: Compulsory

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.

Courses				
Title		Тур	Hrs/wk	СР
Building Physics (L0217)		Lecture	2	2
Building Physics (L0219)		Recitation Section (large)	1	1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materials (L02:		Lecture	2	2
•	Prof. Frank Schmidt-Döhl			
Admission Requirements				
	Knowledge of physics, chemistry and mathematics from	n school		
Knowledge				
_	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
-	The students are able to identify fundamental effects of		•	
	behaviour, to describe the structure of building ma	iterials and the correlations between	structure and	other properties, to
	show methods of joining and of corrosion processes	and to describe the most important re	gularities and p	roperties of building
	materials and structures and their measurement in the	field of protection against moisture, co	ldness, fire and i	noise.
Skills	The students are able to work with the most importan	at standardized methods and regularities	s in the field of	moisture protection
	the German regulation for energy saving, fire protection			moistare protection,
	the definant regulation for energy saving, me protection	if and noise protection in the case of a	and building.	
Personal Competence				
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge.			
4				
Autonomy	The students are able to make the timing and the oper	ation steps to learn the specialist knowl	edge of a very e	extensive field.
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination				
Examination duration and	2 h written exam			
scale				
-	General Engineering Science (German program): Speci	_		ory
_	General Engineering Science (German program, 7 sem		Compulsory	
	Civil- and Environmental Engineering: Core Qualificatio			
	General Engineering Science (English program): Specia	lisation Civil- and Enviromental Engene	ering: Compulso	ry
	General Engineering Science (English program, 7 seme	ester): Specialisation Civil Engineering: (Compulsory	
	Technomathematics: Specialisation III. Engineering Sci	ence: Elective Compulsory		

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

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

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

Course L0215: Principles of Building Materials	
Тур	Lecture
Hrs/wk	2
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
	Principles of metals
	Joining methods
	Corrosion
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3
	Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8
Literature	

Module M0740: Struct	tural Analysis I			
Courses				
Title		Тур	Hrs/wk	СР
Structural Analysis I (L0666)		Lecture	2	3
Structural Analysis I (L0667)		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I, Mathematics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	After successfully completing this module, students can	express the basic aspects of linear for	rame analysis of s	tatically determinate
	systems.			
Skills	After successful completion of this module, the student	s are able to distinguish between sta	atically determina	te and indeterminate
Skiiis	structures. They are able to analyze state variables a		-	
	frame and truss structures.		,	
Personal Competence				
Social Competence	Students can			
·				
	 participate in subject-specific and interdisciplinar 	y discussions,		
	defend their own work results in front of others			
	promote the scientific development of colleagues			
	 Furthermore, they can give and accept profession 	nal constructive criticism		
Autonomy	The students are able work in-term homework assignr	ments. Due to the in-term feedback,	they are enable	d to self-assess their
	learning progress during the lecture period, already.		,	
	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
	Written exam			
Examination duration and	90 Minuten			
scale				
Assignment for the	General Engineering Science (German program): Specia			ory
Following Curricula	General Engineering Science (German program, 7 seme		g: Compulsory	
	Civil- and Environmental Engineering: Core Qualification			
	General Engineering Science (English program): Special			ory
	General Engineering Science (English program, 7 semes		: Compulsory	
	Technomathematics: Specialisation III. Engineering Scie			
	Technomathematics: Specialisation III. Engineering Scie	nce: Elective Compulsory		

Course L0666: Structural Ana	alysis I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	basics: statically determinacy, equilibrium, method of sections forces: determination of support reactions and internal forces influence lines of forces displacements: calculation of discrete displacements and rotations, calculation of deflection curves principle of virtual displacements and virtual forces work-engergy theorem differential equation of beam
Literature	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

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

Module M0590: Buildi	ing Materials and Building Chemistr	у		
Courses				
Title		Тур	Hrs/wk	СР
Building Materials and Building Che		Lecture	4	4
Building Materials and Building Che	emistry (L0249)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Module Principles of Building Materials and Building	Physics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	The students are able to explain the most important characteristics of the mechanical behaviour and the relevant building materials.	·		·
Skills	The students are able to assess the usability of building materials for different applications and to select building materials according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concrete and to consider the mixture in respect 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				
Social 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.			
Autonomy	The students are able to make the timing and the op	peration steps to learn the specialist ki	nowledge of a very e	extensive field.
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and	2 h written exam		<u> </u>	
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Civil Engineeri	ng: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Core Qualifica	tion: Compulsory		
	General Engineering Science (English program, 7 ser	mester): Specialisation Civil Engineerir	ng: Compulsory	

Course L0248: Building Mate	Course L0248: Building Materials and Building Chemistry	
Тур	Lecture	
Hrs/wk	4	
СР	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 Materials and Building Chemistry	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl, Rene Sanmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0706: Geote	echnics I			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L0551)		Recitation Section (large)	2	2
Soil Mechanics (L1493)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules :			
Knowledge	Mechanics I-II			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students know the basics of soil mechanics as t	he structure and characteristics of soil, st	ress distribution	due to weight, water
	or structures, consolidation and settlement calculati	ons, as well as failure of the soil due to gr	ound- or slope fa	ilure.
Skills	After the successful completion of the module the s	students should be able to describe the m	nechanical prope	rties and to evaluate
	them with the help of geotechnical standard tests	. They can calculate stresses and defor	mation in the so	ils due to weight or
	influence of structures. They are are able to prove the	he usability (settlements) for shallow foun	dations.	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German program): Sp	ecialisation Civil- and Enviromental Engen	eering: Compuls	ory
Following Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Civil Engineering:	Compulsory	
	Civil- and Environmental Engineering: Core Qualifica	ition: Compulsory		
	General Engineering Science (English program): Spe	ecialisation Civil- and Enviromental Engene	eering: Compulso	ry
	General Engineering Science (English program, 7 se	mester): Specialisation Civil Engineering:	Compulsory	
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		

Course L0550: Soil Mechanic	
	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Jürgen Grabe
Language	
Cycle	5056
Content	 Structure of the soil Ground surveying Compstition and properties of the soil Groundwater One-dimensional compression Spreading of stresses Settlement calculation Consolidation Shear strength Earth pressure Slope failure Ground failure Suspension based earth tenches
Literature	 Vorlesungsumdruck, s. ww.tu-harburg.de/gbt Grabe, J. (2004): Bodenmechanik und Grundbau Gudehus, G. (1981): Bodenmechanik Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau Grundbau-Taschenbuch, Teil 1, aktuelle Auflage

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

Course L1493: Soil Mechanics	
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	SoSe
Content	See interlocking course
Literature	See interlocking course

riodaic rioozor itemio	orced Concrete I			
Courses				
Title		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 Rombach			
Admission Requirements	None			
Recommended Previous	Basic knowledge in structural analysis and building materi	als.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and of structural members.			
	The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.			
Personal Competence				
Social Competence				
Autonomy	The students are able to carry out simple tasks in the cond	eption and dimensioning of struct	ures and to critica	lly reflect the results.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program): Specialis	ation Civil- and Enviromental Enge	neering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semeste	er): Specialisation Civil Engineering	g: Compulsory	
	Civil- and Environmental Engineering: Core Qualification: 0	Compulsory		
	General Engineering Science (English program): Specialisa	tion Civil- and Enviromental Enger	neering: Compulso	ry
	General Engineering Science (English program, 7 semeste	r): Specialisation Civil Engineering	: Compulsory	

Course L0896: Project Seminar Concrete I		
Seminar		
1		
1		
Independent Study Time 16, Study Time in Lecture 14		
Prof. Günter Rombach, Dr. Björn Schütte		
DE		
SoSe SoSe		
In the course of the project seminar, a simple structure is drafted and dimensioned.		
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: :		

Course L0303: Reinforced Concrete 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	
	The following subjects/contents are treated: • history of concrete construction • mechanical and physical-chemical properties od concrete and steel • bond between concrete and reinforcement • concepts for dimensioning, limit state models, structural safety • design of linear members for tension and bending with and without axial force Download der Unterlagen zur Vorlesung über Stud.IP!	
Literature	Download der Ontenagen zur voriesung über Stüd.ir:	

Course L0305: Reinforced Concrete Design I		
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0744: Struc	tural Analysis II			
Courses				
Title		Тур	Hrs/wk	СР
Structural Analysis II (L0673)		Lecture	2	3
Structural Analysis II (L0674)		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I/II			
Knowledge	Mathematics I/II			
	Differential Equations I			
	Structural Analysis I			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	After successful completion of this module, studen	ts can express the basic aspects o	f linear frame a	nalysis of statically
	indeterminate systems.			
Skills	After successful completion of this module, the stude	ents are able to analyze state variable	es and to constru	ict influence lines of
	statically inderminate plane and spatial frame and trus	s structures.		
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdisciplina defend their own work results in front of others.	ry aiscussions,		
	 defend their own work results in front of others promote the scientific development of colleague 	ac.		
	Furthermore, they can give and accept profession			
Autonomy	The students are able to work in-term homework assignment	gnments. Due to the in-term feedback,	they are enable	d to self-assess their
	learning progress during the lecture period, already.			
		b .		
Credit points				
Examination				
Examination duration and	90 Minuten			
scale	Conoral Engineering Science (Correct progress) Section	alication Civil and Environmental Environ	poorings Committee	201
-	General Engineering Science (German program): Speci			ory
Following Curricula	General Engineering Science (German program, 7 sem Civil- and Environmental Engineering: Core Qualificatio		Compuisory	
	General Engineering Science (English program): Specia		eering: Compulso	rv
	General Engineering Science (English program, 7 seme			: 7
	The second second (English program, 7 sellie	, opening.		

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

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

Module M0611: Steel	Structures I			
Courses				
Title		Тур	Hrs/wk	СР
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	Structural analysis I, Structural analysis II Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	Principles of Building Materials and Building Physics	CS		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	After passing this module students are able to			
	give a summary of the security concept			
	give a summary of the security concept explain the priciples of the design process			
	describe and illustrate the bhaviour of memers in tension, compression and bending			
	describe and mastrate the shartour of memers in	tension, compression and senaing		
Skills	Students can rate and apply the material steel appropia	tely with respect to its properties and	usage.	
	They can use the security concept with respect to loads, forces and resistances.			
	They can check the ultimate limit state and the servicea	bility of simple members in tension, c	compression and	bending.
Personal Competence				
Social Competence	After participation of an optional course (building of a	simple truss) they are able to organiz	e themselves in	groups. They will be
	successful in guided building a truss with bolted connec	tions according to design drawings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	120 minutes		·	
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Civil Engineering:	Compulsory	·
Following Curricula	Civil- and Environmental Engineering: Core Qualification	: Compulsory		
	General Engineering Science (English program, 7 semes	ter): Specialisation Civil Engineering:	Compulsory	

Course L0299: Steel Structur	res I
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	WiSe
Content	Introduction to steel constructions Materials Design and security model Tension rods Beams (elsatic and plastic design Column design Bolted connections
Literature	Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 Band 1 Tragwerksplanung, Grundlagen Band 2 Verbindungen und Konstruktionen

Course L0300: Steel Structur	ourse 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		

Module M0728: Hydra	nulic Engineering I			
Courses				
Title Hydrology (L0909)	Typ Hrs/wk CP Lecture 1 1			
Hydrology (L0956) Hydromechanics (L0615) Hydromechanics (L0616)	Project-/problem-based Learning 1 2 Lecture 2 2 Recitation Section (large) 1 1			
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Mathematics I, II and III			
Knowledge	Mechanics I und II			
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.			
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, they are able to run, explain and document basic hydraulic experiments. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems. In addition, the basic concepts of field - measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements.			
Personal Competence				
Social Competence	The students are able to work in groups in a goal-orientated, structured manner. They can explain their results by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentations for given topics in groups.			
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding of the			
scale	lecture contents and calculations tasks.			
Assignment for the		Civil Engineering: Con	mpulsory	
Following Curricula		0. 1. 5		
	General Engineering Science (English program, 7 semester): Specialisation	Civil Engineering: Con	npulsory	

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

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

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

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

Module M0628: Wate	r Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (L0251)		Lecture	1	1
Groundwater Hydrology (L0252)		Recitation Section (large)	1	2
Water Management and Water Qua	ality (L0366)	Lecture	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Mathemaics I to III; Water Engineering I, Chem	istry		
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students are able to define terms of the hydro	ologic cycle and also parameters to identify th	e water quality.	Typical aquifer types
3	and the occuring flow and storage processe.			
	mathematical description of flow processes as	well as their solution. They are in a position	to explain the ph	ysical background of
	well hydraulics. Fundamentals of solute transp	ort can be reflected.		
Skills	Students are able to use fundamental relation	ships of hydrology and water management for	the solution of p	ractical issues. They
	are in a position to rate water quality data ar	nd to set up hydrological water balances. The	y are able to cor	nstruct ground water
	contour lines and streamlines on the basis of	head data. They have the ability to analyse d	ata of hydraulic	field and lab tests to
	determine hydraulic conductivities and storage	coefficients.	-	
Personal Competence	j			
Social Competence	Students are able to help each other solving ca	ase studies.		
Autonomy	Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Civil Engineering	: Elective Compul	sory
Following Curricula	Civil- and Environmental Engineering: Core Qu	alification: Compulsory		
	General Engineering Science (English program	, 7 semester): Specialisation Civil Engineering:	Elective Compuls	sory

Course L0251: Groundwater Hydrology				
Тур	Lecture			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Wilfried Schneider			
Language	DE			
Cycle	WiSe			
Content	Hydrologic water bilance, aquifertyps, groundwater velocities, Darcy law, groundwater contour lines, storage capacity, flow			
	equation, pumping tests, method of Beyer, solute transport in groundwater			
Literature	Todd; K. (2005): Groundwater Hydrology			
	Fetter, C.W. (2001): Applied Hydrogeology			
	Hölting & Coldewey (2005): Hydrogeologie			
	Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport			

Course L0252: Groundwater Hydrology		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0366: Water Management and Water Quality				
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Mathias Ernst			
Language	DE			
Cycle	WiSe			
Content	The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview:			
	Water balance, water availability , water scarcity, water recycling			
	Water quality parameter (organic, inorganic), assessment and decision support tools.			
Literature	Teil Wasserwirtschaft:			
	 Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001 Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011 Pdf der Vorlesung 			

	duction to Control Systems				
Courses					
Title Introduction to Control Systems (LC		Hrs/wk	CP 4		
Introduction to Control Systems (LC		2	2		
Module Responsible					
Admission Requirements	None				
Recommended Previous	Representation of signals and systems in time and frequency domain, Laplace transform				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	Students can represent dynamic system behavior in time and frequency domain, and can i	in particular e	explain properties of		
	first and second order systems				
	They can explain the dynamics of simple control loops and interpret dynamic properties in the dynamic properties in t	terms of frequ	uency response an		
	root locus				
	 They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops 				
	They can explain the voic of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency res	sponse			
	They can explain issues arising when controllers designed in continuous time domain are in	nplemented d	igitally		
Skills					
SKIIIS	Students can transform models of linear dynamic systems from time to frequency domain a	and vice versa	a .		
	They can simulate and assess the behavior of systems and control loops				
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can apply a and synthesize simple control leads with the help of root leads and frague.	nev rosnonco	tochniques		
	 They can analyze and synthesize simple control loops with the help of root locus and freque They can calculate discrete-time approximations of controllers designed in continuous 				
	implementation	ous anno anno	ase it io. aigit		
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the	ese tasks			
Personal Competence					
	Students can work in small groups to jointly solve technical problems, and experimentally validate	their control	ler designs		
•	Autonomy Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and u when solving given problems.				
		ss			
	They can assess their knowledge in weekly on-line tests and thereby control their learning progres	ss.			
		55.			
		55.			
Workload in Hours	They can assess their knowledge in weekly on-line tests and thereby control their learning progres	55.			
Workload in Hours Credit points	They can assess their knowledge in weekly on-line tests and thereby control their learning progres	55.			
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Credit points	They can assess their knowledge in weekly on-line tests and thereby control their learning progres Independent Study Time 124, Study Time in Lecture 56 Written exam	55.			
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

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
	Prof. Herbert Werner
Language	
Cycle	
Content	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 design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools
	Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0631: Concr	rete Structures II			
Courses				
Title		Тур	Hrs/wk	СР
Project Concrete Structures II (L0894)		Project Seminar Lecture	1 2	1 3
			2	2
Module Responsible	Prof. Günter Rombach			_
Admission Requirements				
Recommended Previous Knowledge	Knowledge of loads on structures and combinatio Basics of safety format are required. Knowledge in design of beams and columns for u Lecture 'Concrete Structures I'			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students know the basic principles which arev required for design of reinforced concrete structures. They know the various methods to estimate the member forces in simple one and two-way slabs.			
Skills	 The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.). The students can estimate the member forces of simple slabs. The students know the content and the layout of a structural analysis 			
Personal Competence				
	Cooperation in a project work, where they design in a te	am a real concrete building and pres	ent the results at	the end.
Autonomy		3,		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Civil Engineering	: Elective Compul	sory
Following Curricula	Civil- and Environmental Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Civil Engineering:	Elective Compuls	sory

ourse 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	Dr. Björn Schütte
Language	DE
Cycle	WiSe
Content	Design of a truss structure
Literature	Skript zur Lehrveranstaltung "Stahlbetonbau II"

Course L0348: Concrete Stru	actures 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 plates Layout and content of a structural design
	 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.

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	

Ca				
Courses			Here feels	CD.
Fitle Computer Engineering (L0321)	Typ Lecture		Hrs/wk 3	CP 4
Computer Engineering (L0324)	Recitation Se	ction (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning re	esults		
Professional Competence				
Knowledge	This module deals with the foundations of the functionality of computing significant programming down to gates. The module includes the following topics:	ystems. It covers t	he layers from	n the assembly-le
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardw Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and endowed by Basics of computer architecture: Programming models, MIPS single-cycles Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing 	division cle architecture, pip	pelining	
Skills	The students perceive computer systems from the architect's perspective, i.e composition of computer systems. The students can analyze, how highly specollection of few and simple components. They are able to distinguish betw	cific and individual een and to explain	computers car	n be built based or
	today's computing systems - from gates and circuits up to complete processor. After successful completion of the module, the students are able to judge system and the software executed on it. In particular, they shall understand on the hardware-centric abstraction layers from the assembly language dow the impact that these low abstraction levels have on an entire system's performance.	the interdependen the consequences n to gates. This wa	that the execu y, they will be	ution of software h enabled to evalua
Personal Competence				
	Students are able to solve similar problems alone or in a group and to presen	t the results accord	lingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to as	sociate this knowle	adae with other	r classes
Autonomy	Students are able to acquire new knowledge from specific interactive and to as	isociate this knowle	age with other	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination				
	90 minutes, contents of course and labs			
Scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation C	omputer Science:	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation B			irv
1 onowing curricula	General Engineering Science (German program, 7 semester): Specialisation N			y
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0878: Applications in Civil and Environmental Engineering				
Courses				
Title	Тур)	Hrs/wk	СР
Applied Structural Dynamics (L079	1) Lect	ture	2	2
Building Information Modeling (L19	03) Lect	ture	1	1
Building Information Modeling (L19	04) Proje	ect-/problem-based Learning	2	2
Computational Analysis of Structur	es (L0370) Lect	ture	2	3
Introduction in Statitics with R (L0286) Lecture 1		1	1	
Introduction in Statitics with R (L07	76) Reci	itation Section (large)	1	1
Principles of Geomatics (L0470)	Lect	ture	2	2
Principles of Geomatics (L0471)	Reci	itation Section (small)	2	2
Numeric and Matlab (L0125)	Prac	ctical Course	2	2
Practical Course in Drinking Water	Chemistry (L1744) Prac	ctical Course	1	2
Projects II (L1228)	-	ect Seminar	2	2
Fire Protection and Prevention (L04			2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	The students are at home doing with typical applications of the study	programme.		
Skills	The students are able to use the methods that are provided during th	ne lectures for practical ques	stions. They are	able to work in t
	learnt methods into new forms of application independently".			
Personal Competence				
Social Competence	According to the course chosen students are able to perform tasks	s or to conduct a project in	n teams. If so,	they can preser
	discuss and document results accordingly.			
Autonomy	According to the course chosen individual students can plan and docu	ument tasks and work flow f	or themselves of	or for the team.
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the	General Engineering Science (German program, 7 semester): Speciali	isation Civil Engineering: Ele	ective Compulso	ory
Following Curricula	Civil- and Environmental Engineering: Core Qualification: Compulsory			
3	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory			
-	denotal Engineering defence (Engilon program, 7 definester). Specialis	Sacrott Sivil Engineering. Elec	care compaison	1

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

Course L1903: Building Infor	mation Modeling
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and	siehe Modulhandbuch
scale	
Lecturer	Prof. Frank Schmidt-Döhl, Thomas Kölzer
Language	DE
	WiSe/SoSe
Content	Basic knowledge of Building Information Modeling:
	Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)
	Current standards and guidelines (national and international standardisation, structures)
	Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)
	Object oriented modeling (requirements, structure, classification, parts catalogues)
	BIM-Implementation (structures, cycles, professions, job profiles, execution plan)
	BIM-Tools (software, hardware, application areas)
	Execution examples (national and international construction projects)
	Basic knowledge for the use of the software Allplan 2018:
	Basic settings (project administration, building structures, fileset structures, layers)
	Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)
	Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)
	Dimensioning and text adding of designed elements and structural components
	Generating of areas (hatchings, patterns, fills)
	Construction fundamentals 3D (floor concept, floor manager, building structures)
	Walls and columns (height definitions, parameters, attributes, format properties)
	Slabs (height definitions, parameters, attributes, format properties)
	Use of libraries (u. a. furnitures, surroundings etc.)
	Opening Elements and SmartParts (doors and windows)
	Stairs and ramps (stair wizard, IFC-Ramp)
	Roof frame and roof covering (custom planes, parameters, attributes, format properties)
	Attributes and characteristic values (allocations and modifications)
	Export and Import of IFC-Data (basics, floor allocation, fileset selection)
	Generating of sections and views (architecturial sections and associative sections)
	Generating of printable drawings (layouts, scales, page settings)
Literature	_
Elterature	

Course L1904: Building Information Modeling	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	siehe Modulhandbuch
scale	
Lecturer	Prof. Frank Schmidt-Döhl, Thomas Kölzer
Language	DE
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0370: Computational Analysis of Structures		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and	60 min	
scale		
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	 basics of the Finite Element Method, Spreadsheets basics of software 'SOFiSTiK' modeling of an arbitrary cross-section modeling of an arbitrary 2D truss structure incl. loads Teddy; usage of global and local variables design of a concrete section modeling of a T-beam bridge by means of a grillage system modeling and design of a rectangular slab building models 	
Literature	 Vorlesungsunterlagen können im STUDiP heruntergeladen werden Tutorials von SOFiSTiK Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &.Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36) 	

Course L0286: Introduction i	n Statitics with R		
Тур	Lecture		
Hrs/wk			
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Examination Form	Klausur		
Examination duration and	60 min		
scale			
Lecturer	Dr. Joachim Behrendt		
Language	DE		
Cycle	WiSe		
Content	Introduction to R		
	Graphics with R		
	Descriptive Statistic (Boxplot, Percentiles, outliers)		
	Propability (Combinatorics, relative frequency, dependand probability)		
	random numbers and distibutions (confidence interval, uniform and discrete distributions, test-distributions (t-F-X²-distribiution))		
	Correlation and Regression analysis (Confidence interval of calibration curves, linearity)		
	Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test)		
	Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)		
	ntroduction time series (tseries)		
	Introduction cluster analysis (k-means)		
Literature	Regionales Rechenzentrum für Niedersachsen		
	Statistik mit R		
	Grundlagen der Datenanalyse		
	, 2013		
	Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld		
	http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf		
	und die dazugehörige Aufgabensammlung		
	http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf		
	Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge		
	von Toutenburg, Helge 2008		
	http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2		
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran.r-project.org/doc/contrib/Short-refcard.pdf		
	Grafiken und Statistik in R von Andreas Plank		
	Nachschlage Skript mit Beispielen: http://www.geo.fu-		
	berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fu-berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf		
	<u> </u>		

Course L0776: Introduction in Statitics with R	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	siehe Vorlesung
scale	
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0470: Principles of Geomatics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur	
scale		
Lecturer	Prof. Peter Andree	
Language	DE	
Cycle	SoSe	
Content	 Overview of geomatics in general Units of measurements Generating of topographical maps Basic surveying instruments and handling Geodetic surveying lines and verification of measurements Methods of horizontal survey Components of geodetic surveying instruments Height determination Setting out points Topographical survey Directions and angles Determination of coordinates Traversing Basics on surveying and positioning with GNSS 	
Literature	Andree, P.: Grundlagen der Geomatik (Skript) Resnik, B. / Bill, R.: Vermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmann-verlag Witte, B. / Sparla, P.: Vermessungskunde und Grundlagen der Statistik für das Bauwesen, Wichmann-Verlag Gruber, F.J. / Joeckel, R.: Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag	

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

Course L0125: Numeric and Matlab	
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and	5 Übungsaufgaben jeweils mit Testat am Ende
scale	
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Course L1744: Practical Course in Drinking Water Chemistry	
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and	6 Versuchsprotokolle
scale	
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	!Max.12 students!
	The students learn basic experimental work in the laboratory. The experiments give an overview about the most important
	chemical analysis methods of drinking water. This includes sampling, photometric measurement, complexometric titration as well
	as acid/base titration. The experiments are strongly related to the processes in drinking water treatment and water distribution (e.
	g. removal of iron and manganese, softening and conditioning). Instrumental analytics is not subject of this practical course.
	1. Day: Introduction, safety instructions
	2. Day: Electrical conductivity, saturation with respect to calcite, hardness
	3. Day: Organic carbon, iron, acid and base neutralization capacity
	4. Day: Writing protocols of experiments and presentations
	5. Day: Evaluation of the protocols and presentations, final discussion
Literature	Siehe Skript.
	See Script.

Course L1228: Projects II	
Тур	Project Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	ca. zehnminütige Präsentation
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Excursions to different construction and environmental projects.
Literature	keine

Course L0472: Fire Protection and Prevention	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Philipp Below
Language	DE
Cycle	SoSe
Content	 Introduction fire in residential and office buildings town planning: location of residential, office and industry areas, location of fire stations design of roads an water pipes explosions
Literature	Schneider U.: Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002

Module M0755: Geote	echnics II			
Courses				
Title		Тур	Hrs/wk	СР
Foundation Engineering (L0552)		Lecture	2	2
Foundation Engineering (L0553)		Recitation Section (large)	2	2
Foundation Engineering (L1494)	I	Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
	Modules:			
Knowledge	Mechanics I-II			
	Geotechnics I			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The students know the basic principles and metho	ds which are required to verificate the stab	ility of geotechnic	al structures.
Skills	After successful completion of the module the stud	lents are able to:		
	·			
	verificate the stability and usability of found			
	know individual methods of ground improve	ment and apply them in their range of app	lication,	
	design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	2 84		
Credit points	6			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Civil Engineering	Elective Compul	sory
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Civil Engineering	Elective Compul	sory
	Civil- and Environmental Engineering: Core Qualific	cation: Compulsory		
	Civil- and Environmental Engineering: Core Qualific	cation: Compulsory		
	General Engineering Science (English program, 7 s	emester): Specialisation Civil Engineering:	Elective Compuls	ory
	General Engineering Science (English program, 7 s	emester): Specialisation Civil Engineering:	Elective Compuls	ory
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		

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

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

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

Module M0829: Foun	dations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882)		Recitation Section (large)	2	3
Introduction to Management (L088		Lecture	3	3
Module Responsible	·			
Admission Requirements Recommended Previous				
Knowledge				
Educational Objectives		d the following learning results		
Professional Competence	,			
Knowledge	After taking this module, students know the importa and Organisation to Marketing and Innovation, and a			
	explain the differences between Economics important definitions from the field of Manage explain the most important aspects of and g projects describe and explain basic business functions organization and human ressource managem. explain the relevance of planning and decuncertainty, and explain some basic methods state basics from accounting and costing and	ement oals in Management and name the most ons as production, procurement and so ent, information management, innovation ision making in Business, esp. in situal from mathematical Finance	important aspe ourcing, supply management ar	cts of entreprneuria chain management d marketing
Skills	Students are able to analyse business units with resout an Entrepreneurship project in a team. In particu		jectives, strateg	ies etc.) and to carr
 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 				
Personal Competence				
Social Competence	Students are able to			
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 students are able to work in a team and to organize the team then	dents.	herent report or	the project
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Subject theoretical and practical work			
	several written exams during the semester			
scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se			/
rollowing curricula	General Engineering Science (German program, 7 se	· ·		nrv
	General Engineering Science (German program, 7 se			,
	General Engineering Science (German program, 7 se	•		
	General Engineering Science (German program, 7 se	emester): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (German program, 7 se	emester): Specialisation Civil Engineering:	Compulsory	
	General Engineering Science (German program, 7 se		_	
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering,	ocus Mechatronic
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, F	ocus Biomechanic
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical I	Engineering, Foo	us Aircraft System
	Engineering: Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanic
	Engineering: Compulsory General Engineering Science (German program, 7 s and Production: Compulsory		-	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical E	Engineering, Foo	us Energy System

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course L08	182: Management Tutorial	
Tyn	Recitation Section (large)	

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

WiSe/SoSe Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Module M0579: Struc	tural Design			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Structural Design (L0205)		Lecture	2	1
Exercises in Structural Design (L02	08)	Recitation Section (large)	1	1
Seminar in Structural Design (L020	9)	Project-/problem-based Learning	2	4
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Contents of module "Principles of Building Materi	als and Building Physics"		
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	After attending the course students are able			
	to define the basics of building regulations	s law		
	to specify typical building components			
		bearing behaviour and risks due to lack of stab	ility	
	to explain the main objectivs of fire contro	ı		
Skills	After attending the course students are able			
	to evaluate development plans and to con	vert the main objectivs of building regulation la	ws to a archit	ect's plan
	, ,	 to evaluate development plans and to convert the main objectivs of building regulation laws to a architect's plan to decide which building components should be used to get a correcct building enevelope and a sufficient building stability 		
	to decide which ballding components should be used to get a correct ballding enevelope and a sufficient ballding stability to proof the moisture behaviour, the energy consumption, the acoustic protection and the fire control of a construction			
	to plot the results of drafts and decisions			
Personal Competence				
Social Competence	After attending the course students are able			
	to work in a team and to persent the resul	ts of the team work		
	to use the feedback from other students to improve the own results			
	 to give a feedback to other students in a c 	onstructive manner		
Autonomy	After attending the course students are able			
	to control and improve their knowledge wi	th the help of weeekly presentations (lecture ro	om) and tests	(STUD.IP)
	,	to deduce the needed knowledge and to schedul		
		Š		·
Workload in Hours	Independent Study Time 110, Study Time in Lect	ture 70		
Credit points	, , , , , , , , , , , , , , , , , , , ,			
Examination	Subject theoretical and practical work			
Examination duration and	,	ten theory exam		
scale		-		
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Civil Engineering: Co	mpulsory	
Following Curricula	Civil- and Environmental Engineering: Core Quali	fication: Compulsory	-	
-	General Engineering Science (English program, 7	semester): Specialisation Civil Engineering: Cor	mpulsory	

Course L0205: Basics of Stru	ctural Design
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Thomas Kölzer
Language	DE
Cycle	
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
	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
	Neufert, Ernst (Kister, Johannes)
	Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn,
	Lehrenden und Lernend
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Course L0208: Exercises in S	tructural Design
Tvp	Recitation Section (large)
Hrs/wk	1
CP	1
	Independent Study Time 16, Study Time in Lecture 14
Lecturer	
Language	
Cycle	
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 funcionality (sealing, facades, roofs)
	Design and approve of the funcionality of the component interconnections Description and approve of prairies and the private appropriate appropriate production and fire control.
	Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control Assessing the building stability.
	Assessing the building stabilty Basics of building services
	Each week the results of different work steps are presented in oral and written form
	Lach week the results of different work steps are presented in ordinal 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 Maus Lüssen (Coris Alfans - Borner Maus)
	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
	Alexander Promote (Workers Laborators)
	Neufert, Ernst (Kister, Johannes)
	Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Course L0209: Seminar in St	ructural Design	
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	4	
	Independent Study Time 92, Study Time in Lecture 28	
Lecturer		
Language		
Cycle		
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 funcionality (sealing, facades, roofs)	
	Design and approve of the funcionality of the component interconnections	
	Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control	
	Assessing the building 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	
	Biarle Mana (Marrotth Didicar)	
	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	
	Manufactures Balactured (Materill, Otto W., Dougraphy or Hamila, Doubrahas Institut ("a Nagraphy)	
	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	
	Stategare [a.a.] . Teablier bernin [a.a.] . beach, 2007	
	Neufert, Ernst (Kister, Johannes)	
	Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für	
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn,	
	Lehrenden und Lernenden	
	ISBN: 978-3-8348-0732-8 (GB.)	
	Wiesbaden : Vieweg + Teubner, 2009	

Module M0686: Sanit	ary Engineering			
Courses				
Title Wastewater Disposal (L0276) Wastewater Disposal (L0278) Drinking Water Supply (L0306) Drinking Water Supply (L0308)		Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2	CP 2 1 1 2
Module Responsible	Prof. Ralf Otterpohl	Necreation Section (large)		
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge on Chemistry and Biology			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Personal Competence Social Competence	Social skills are not targeted in this module.			
	Students are able to form concepts on their own to op appropriate knowledge when being given some clues o follow-up of the exercises).			
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German program, 7 semes Civil- and Environmental Engineering: Core Qualification: General Engineering Science (English program, 7 semest	Compulsory		

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

Course L0278: Wastewater Disposal		
Тур	Recitation Section (large)	
Hrs/wk	1	
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 Water Supply		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst	
Language	DE	
Cycle	SoSe	
Content	The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer.	
	Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g. firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems.	
	A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters.	
Literature	Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag. Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag. DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003).	

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

Module M0869: Hydra	aulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L0959)		Lecture	2	2
Hydraulic Engineering (L0960)		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to define the basic terms of hydra	aulic engineering and hydraulics. They	are able to expla	in the application of
	basic hydrodynamic formulations (conservation laws	basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can		
	illustrate important tasks of hydraulic engineering ar	illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power		
	engineering and waterways engineering.			
Skills	The students are able to apply hydraulic engineering	methods and approaches to basic prac	tical problems a	nd design respective
	hydraulic engineering systems. Besides this, they are	e able to use and apply established app	roaches of hydra	aulics and determine
	water surfaces of channel flows, influences of constru	water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system.		
	Furthermore, they are able to run, explain and docum	nent basic hydraulic experiments.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowle	dge in applied problems. Additionaly, th	ney will be able t	o work in team with
	engineers of other disciplines in a goal-orientated,	structured manner. They can explain t	their results by u	use of peer learning
	approaches.			
Autonomy	The students will be able to independently extend the	eir knowledge and apply it to new proble	ms. Furthermore	, they are capable of
	organising their individual work flow to contribute to t	the conduct of experiments and to prese	nt discipline-spec	cific knowledge.
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The ex	camination includes tasks with respect	to the general u	inderstanding of the
scale	lecture contents and calculations tasks.			-
Assignment for the	General Engineering Science (German program, 7 ser	mester): Specialisation Civil Engineering:	Elective Compul	sory
Following Curricula	Civil- and Environmental Engineering: Core Qualificati	ion: Compulsory		
	General Engineering Science (English program, 7 sem	nester): Specialisation Civil Engineering:	Elective Compuls	ory

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

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

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

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

Specialization Bioprocess Engineering

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

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

Module M0886: Funda	amentals of Process Engineering and	d Material Engineering		
Courses				
Title Introduction into Process Engineering Fundamentals of material engineer		Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After passing this module the students have the abili	ty to:		
	give an overview of the most important fields explain some working methods for different fields		ering,	
Skills	After passing this module the students should have the ability to: • list and outline the most important fields of process engineering, • name the most important working approaches or methods of the different fields of process engineering, • read and prepare an engineering drawing, • explain the most important technologies for wastewater and exhaust air treatment • scheme typical chemical and biotechnological processes independently with the aid of pointers.			
Personal Competence Social Competence	The students are able to work out results in groups and document then provide appropriate feedback and handle feed		onstructively.	
Autonomy	The students are able to estimate their progress of Engineering and Bioprocess Engineering.	learning by themselves and to d	eliberate their lack of k	nowledge in Process
Workload in Hours	Independent Study Time 34, Study Time in Lecture 5	6		
Credit points	3			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Spe	3 3	. ,	
Following Curricula	General Engineering Science (German program): Spe General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se	•		ry
	Bioprocess Engineering: Core Qualification: Compulso		3 3 11 1	-
	General Engineering Science (English program): Spec	cialisation Bioprocess Engineering	: Compulsory	
	General Engineering Science (English program): Spec	cialisation Process Engineering: Co	mpulsory	
	General Engineering Science (English program, 7 sen			
	General Engineering Science (English program, 7 sen	nester): Specialisation Bioprocess	Engineering: Compulsor	у
	Process Engineering: Core Qualification: Compulsory			

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

Course L0830: Fundamentals	s of material engineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Literature	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.

Module M0730: Comp	outer Engineering	
Courses		
Title	Typ Hrs/wk CP	
Computer Engineering (L0321)	Lecture 3 4	
Computer Engineering (L0324)	Recitation Section (small) 1 2	
Module Responsible		
Admission Requirements Recommended Previous		
Knowledge		
	The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules:	
	 Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs such that the examination's marks are lifted by 0,3 or 0,4, respectively, up to the next-better grade. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible. 	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches	
Skills	 Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on 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 students are able to judge the interdependencies between a physical compute system and the software executed on it. In particular, they shall understand the consequences that the execution of software ha on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.	
Personal Competence		
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Credit points	6	
Examination	Written exam	
	90 minutes, contents of course and labs	
scale	General Engineering Science (German program): Core Qualification: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen	
	and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program): Core Qualification: Compulsory	

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

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

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

Module M0937: Physi	ical Chemistry		
Courses			
Title	Тур	Hrs/wk	СР
Physical Chemistry (L0833)	Lecture	2	2
Physical Chemistry (L0835)	Practical Course	2	1
Module Responsible			
Admission Requirements			
Recommended Previous Knowledge		natics I-III.	
	After taking part successfully, students have reached the following learning results		
Professional Competence			
	The students are able,		
	-to repeat the basic concepts of physical chemistry		
	-to describe and summarize the underlying concepts of mass-, heat- and momentum tran	nsfer.	
	- to interpret phase diagrams and affiliate kinetic rate laws.		
Skills	The students are able to		
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.		
	- assess new applications with respect to environmental sustainability.		
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemica	l and kinetic calculati	ons.
Personal Competence Social Competence	The students are able to plan, prepare, conduct and document experiments according to	scientific quidelines i	n small groups.
·	The students are able to reflect their subject-specific knowledge orally in a team and to d	iscuss it with fellow st	tudents and faculty.
Autonomy	Students are able to assess their knowldege continuously on their own by exemplified knowldege discretely to plan, prepare and conduct experiments.	practice. Students are	e able to apply their
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56		
Credit points	3		
Examination	Written exam		
Examination duration and	180 min		
scale			
Assignment for the			
Following Curricula	General Engineering Science (German program): Specialisation Bioprocess Engineering: C General Engineering Science (German program, 7 semester): Specialisation Process Engineering		
	General Engineering Science (German program, 7 semester): Specialisation Process Engin General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Science (German program, 7 semester): S		ompulsory
	Bioprocess Engineering: Core Qualification: Elective Compulsory	.gecg. Elective C	paisor,
	General Engineering Science (English program): Specialisation Process Engineering: Com	pulsory	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Co	ompulsory	
	General Engineering Science (English program, 7 semester): Specialisation Process Engin	eering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess En	gineering: Elective Co	ompulsory
	Process Engineering: Core Qualification: Compulsory		

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

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

Module M0536: Funda	amentals of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (I	_0091)	Lecture	2	4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I+II+III			
Kilowicage	Technical Mechanics I+II			
	Technical Thermodynamics I+II Westing with force haloness.			
	Working with force balancesSimplification and solving of partial different	tial equations		
	Integration	tur equations		
	-			
	After taking part successfully, students have reach	ned the following learning results		
Professional Competence	Children are able to			
кпошейде	Students are able to:			
	explain the difference between different typ			
	give an overview for different applications or			
	 explain simplifications of the Continuity- and 	ว Navier-Stokes-Equation by using physica	ı boundary condit	ons
Skills	The students are able to			
	describe and model incompressible flows makes	athematically		
	reduce the governing equations of fluid med		itative solutions e	g. by integration
	 notice the dependency between theory and 			5 , 5
	 use the learned basics for fluid dynamical a 	pplications in fields of process engineering	ı	
Personal Competence				
Social Competence	The students			
,				
	 are capable to gather information from sub of the lecture and 	ject related, professional publications and	relate that inforn	nation to the context
	able to work together on subject related ta	sks in small groups. They are able to pre-	sent their results	effectively in English
	(e.g. during small group exercises)	3 - 1 - 1 - 3 - 1 - 1 - 1 - 1 - 1 - 1 -		, ,
	are able to work out solutions for exercises	by themselves, to discuss the solutions or	ally and to presen	t the results.
Autonomy	The students are able to			
	search further literature for each topic and to			
	 work on their exercises by their own and to 	evaluate their actual knowledge with the i	ееараск.	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination				
Examination duration and	3 hours			
scale				
	General Engineering Science (German program): S			
Following Curricula	General Engineering Science (German program): S			
	General Engineering Science (German program): S General Engineering Science (German program, 7	•		sury
	General Engineering Science (German program, 7			orv
	General Engineering Science (German program, 7			
	Bioprocess Engineering: Core Qualification: Compu	ılsory		
	Energy and Environmental Engineering: Core Qual	' '		
	General Engineering Science (English program): Sp	, , , , , , , , , , , , , , , , , , , ,		
	General Engineering Science (English program): Sp			sory
	General Engineering Science (English program): Sp			
	General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s			v
	General Engineering Science (English program, 7 s			
	Technomathematics: Specialisation III. Engineering		3	
	Process Engineering: Core Qualification: Compulso	ry		

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

Course L0003: Eluid Machani	ics for Drocoss Engineering	
Course L0092: Fluid Mechani Typ		
Hrs/wk		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
	Prof. Michael Schlüter	
Language		
Cycle		
_	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel	
	to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.	
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. 	

Module M0757: Bioch	emistry and Microbiology			
Courses				
Title Biochemistry (L0351) Biochemistry (L0728) Microbiology (L0881) Microbiology (L0888)		Typ Lecture Project-/problem-based Learning Lecture Project-/problem-based Learning	Hrs/wk 2 1 2 1	CP 2 1 2
Module Responsible	Dr. Paul Bubenheim			
Admission Requirements	None			
-	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ing learning results		
Professional Competence				
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical research to	determine the properties of biom	olecules	
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Skills				
Personal Competence				
_	The students are able,			
,	- to gather knowledge in groups of about 10 students			
	- to introduce their own knowledge and to argue their view in di	scussions in teams		
	- to divide a complex task into subtasks, solve these and to pres			
Autonomy	The students are able to present the results of their subtasks in	a written report		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
	Written exam			
Examination duration and	90 min			
scale	Canada Fasinaasiaa Calanaa (Carman nyaasan) Carada libertian	Dianagas Engineering Committee		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): Sp			ny.
Following Curricula	Bioprocess Engineering: Core Qualification: Compulsory	reciansation bioprocess engineer	ing. Compuiso	' y
	General Engineering Science (English program): Specialisation B	lionrocess Engineering: Compuls	orv	
	General Engineering Science (English program, 7 semester): Specialisation B		-	v
	Technomathematics: Specialisation III. Engineering Science: Elec	·	.5. copaisoi	,

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

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

Course L0881: Microbiology	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	1. The procaryotic cell • evolution • taxonomy and specific properties of Archaea, Bacteria, and viruses • structure and properties of the cell
	growth 2. Metabolism
	 fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy 3. Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles biotechnology
Literature	 Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €) Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/

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

Module M0544: Phase	Equilibria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	СР
Phase Equilibria Thermodynamics (L0114)	Lecture	2	2
Phase Equilibria Thermodynamics (L0140)	Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (L0142)	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Thermodynam	ics I and II		
Knowledge				
Educational Objectives	After taking part successfully, students have read	thed the following learning results		
Professional Competence	The carries pare succession, stadenes have real	and the following feathing results		
Knowledge				
Knowleage	 Starting from the very basics of thermod 	ynamics, the students learn the mathematic	al tools to desc	cribe thermodynamic
	equilibria.			
	 They learn how state variables are influe 	nced by the mixing of compounds and learn	concepts to qu	antitatively describe
	these properties.			
	 Moreover, the students learn how phase 	equilibria can be described mathematically	and which pher	omena may occur if
	different phases (vapor, liquid, solid) coex	ist in equilibrium. Furthermore the fundament	als of reaction e	quilibria are taught.
	 For different phase equilibria, several ex 	amples relevant for different kinds of proce	esses are show	n and the necessary
	knowledge for plotting and interpreting the	e equilibria are taught.		
Skills				
	 Applying their knowledge, the students a 	re able to identify the correct equation for t	he determination	on of the equilibrium
	state and know how to simplify these equa	ations meaningfully.		
	The students know models which can be	used to determine the properties of the syste	em in the equili	orium state and they
	are able to solve the resulting mathematic	al relations.		
	 For specific applications, they are able to 	self-reliantly find necessary physico-chemical	properties of c	ompounds as well as
	model parameters in literature sources.			
	 Beside pure compound properties the stud 	lents are capable of describing the properties	of mixtures.	
	 The students know how to visualize phase 	equilibria graphically and they know how to i	nterpret the occ	urring phenomena.
	 Based on their knowledge, the students 	s are able to understand fundamental con	cepts that are	the basis for many
	separation and reaction processes in chen	nical engineering.		
Personal Competence				
Social Competence	The students are able to work in small groups, t	to solve the corresponding problems and to p	resent them or	aly to the tutors and
	other students			-
Autonomy				
,	The students are able to find necessary in:	formation self-reliantly in literature sources ar	nd to judge their	quality.
	*	able to check their learning progress contin	nuously in exer	cises. Based on this
	knowledge the students can adept their le	arning process.		
Workland in House	Independent Study Time 124, Study Time in Lest	TURO E 6		
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lect	uie 50		
•				
Examination	Written exam			
	120 minutes; theoretical questions and calculation	ons		
scale				
Assignment for the	General Engineering Science (German program):		-	
Following Curricula	General Engineering Science (German program):		-	
	General Engineering Science (German program,	· ·		
	General Engineering Science (German program,	7 semester): Specialisation Bioprocess Engine	ering: Compulso	ory
	Bioprocess Engineering: Core Qualification: Comp	pulsory		
	General Engineering Science (English program):	Specialisation Bioprocess Engineering: Compu	lsory	
	General Engineering Science (English program):	Specialisation Process Engineering: Compulso	ry	
	General Engineering Science (English program, 7	semester): Specialisation Process Engineerin	g: Compulsory	
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engine	ering: Compulso	ry
<u> </u>	Process Engineering: Core Qualification: Compuls	sory		

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

Course L0142: Phase Equilibria Thermodynamics			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	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. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 		

	lls and Systems
Courses	
Title	Typ Hrs/wk CP
Signals and Systems (L0432)	Lecture 3 4
Signals and Systems (L0433)	Recitation Section (small) 2 2
Module Responsible	
Admission Requirements	None Methomotics 1.2
Recommended Previous Knowledge	Mathematics 1-3
Kilowiedge	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathemat
	1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is useful
	but not required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
•	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system
- !	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. The
	can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, the
	understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to
	discrete-time signal.
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal an
	system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase
	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time and frequency domain
Personal Competence	
•	The students can jointly solve specific problems.
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can control their level of
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.
	Independent Study Time 110, Study Time in Lecture 70
Credit points	
Examination	
Examination duration and	90 min
scale	
Assignment for the	
Following Curricula	
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials i
	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	Computer Science: Core Qualification: Compulsory
	Electrical Engineering: Core Qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
ļ	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
1	Mechatronics: Core Qualification: Compulsory
1	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0432: Signals and Systems			
Тур	Lecture		
Hrs/wk	3		
СР	4		
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Gerhard Bauch		
Language Cycle			
Content			
	Basic classification and description of continuous-time and discrete-time signals and systems		
	Concvolution		
	Power and energy of signals		
	Correlation functions of deterministic signals		
	Linear time-invariant (LTI) systems		
	Signal transformations:		
	Fourier-Series		
	Fourier Transform		
	Laplace Transform		
	Discrete-time Fourier Transform		
	Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)		
	• Z-Transform		
	Analysis and design of LTI systems in time and frequency domain		
	Basic filter types		
	Sampling, sampling theorem		
	Fundamentals of recursive and non-recursive discrete-time filters		
Literature	T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004		
	• 1. Frey , M. Bossert , Signal- und Systemineone, B.G. Teubher 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.		

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

Module M0938: Biopro	ocess Engineering - Fundamen	ntals		
Courses				
itle iioprocess Engineering - Fundamer iioprocess Engineering- Fundamen		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3
lioprocess Engineering - Fundamer	ntal Practical Course (L0843)	Practical Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	None			
Recommended Previous Knowledge	none, module "organic chemistry", module "	fundamentals for process engineering"		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
	Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics f enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry are rheology can be named and mass transport processes in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail. After successful completion of this module, students should be able to			of stoichiometry and
	 describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on a fermentation process analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaeroby to compare them as well as to apply them to current biotechnical problem propose solutions to complicated biotechnological problems and to deduce the corresponding models to explore new knowledge resources and to apply the newly gained contents identify scientific problems with concrete industrial use and to formulate solutions. to document and discuss their procedures as well as results in a scientific manner 			wth inhibition on th
	take position to their own opinions and incre	should be able to debate technical questions ase their capacity for teamwork in engineering will be able to solve a technical problem in a	and scientific env	ironments.
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points				
Examination				
Examination duration and	90 min			
scale				
Assignment for the	3 3 . , 3	am): Specialisation Process Engineering: Comp	,	
Following Curricula	General Engineering Science (German programeral Engineering Science (German programeral Engineering Science (German programeral Engineering Science (English programeral Engineering: Specialisation Artifice	am): Specialisation Bioprocess Engineering: Co am, 7 semester): Specialisation Process Engine am, 7 semester): Specialisation Bioprocess Eng Compulsory am): Specialisation Bioprocess Engineering: Compu am): Specialisation Process Engineering: Compu am, 7 semester): Specialisation Process Engineering am, 7 semester): Specialisation Bioprocess Engineering cial Organs and Regenerative Medicine: Compu	ering: Compulsory ineering: Compuls npulsory ilsory ering: Compulsory neering: Compulsory	ory

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

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

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

TitleTypHrs/wkCPHeat and Mass Transfer (L0101)Lecture22Heat and Mass Transfer (L0102)Recitation Section (small)12	Module M0538: Heat	and Mass Transfer			
Lecture Lecture 2 2	Courses				
there and Mest Tracefor (1913)	Title		Тур	Hrs/wk	СР
Mediate Repensible Prof. Irina Smirrosa Admission Requirements. None Recommended Products Knowledge International Thermodynamics International Th	Heat and Mass Transfer (L0101)			2	2
Module Responsible Prof. Irina Snimorus Module Recommended Previous South Recommended Previous Previous South Recommended	Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
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application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowlegde of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems. Personal Competence Social Competence The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors and other students. **The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clickersystem, exam-like assignments) and on this basis they can control their learning processes. Workload in Hours Credit points **Credit points** Independent Study Time 124, Study Time in Lecture 56 Examination duration and scale Assignment for the General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Technomathematics: Spe		for the description and design of apparatus (e.g. ext	raction column, rectification colur	mn).	
In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowlegde of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems. Personal Competence Social Competence • The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors and other students. • The students are able to find and evaluate necessary information from suitable sources • They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 5 6		In this context, the students are capable to choose a	and design fundamental types of	heat and mass exc	changer for a specific
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Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	Credit points	6			
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Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		General Engineering Science (German program, 7 semeste	r): Specialisation Energy and Env	iromental Enginee	ring: Compulsory
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Technomathematics: Specialisation III. Engineering Science: Elective Compulsory					-
				romental Engineer	ing: Compulsory
Process Engineering: Core Qualification: Compulsory			e: Elective Compulsory		
		Process Engineering: Core Qualification: Compulsory			

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

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

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

Module M0546: Therm	nal Separation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01	18)	Lecture	2	2
Thermal Separation Processes (L01	19)	Recitation Section (small)	2	2
Thermal Separation Processes (L01	41)	Recitation Section (large)	1	1
Separation Processes (L1159)		Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence	,	<u> </u>		
Knowledge				
	 The students can distinguish and describe differen 	t types of separation processes	such as distillat	ion, extraction, and
	adsorption			
	The students develop an understanding for the cour.			he estimation of the
	energy demand of a process, the possibilities of energy		aration systems	
	They have good knowledge of designing methods for	separation processes and devices		
Skills				
	Using the gained knowledge the students can select	a reasonable system boundary for	a given separat	tion process and can
	close the associated energy and material balances			
	The students can use different graphical methods	for the designing of a separation	process and de	efine the amount of
	theoretical stages required			
	They can select and design a basic type of therma disadvantages of the presses.	il separation process for a given	case based on	the advantages and
	disadvantages of the process	a panded material properties from	annronriato co	urcos (diagrams and
	 The students are capable to obtain independently th tables) 	e needed material properties from	i appropriate so	urces (diagrams and
	They can calculate continuous and discontinuous pro	raccac		
	The students are able to prove their theoretical know			
	The students are able to discuss the theoretical back			with the teachers in
	colloquium.	J		
	The students are capable of linking their gained knowledge			er for the solution of
	technical problems. Other lectures such as thermodynamics	, fluid mechanics and chemical en	gineering.	
Personal Competence				
Social Competence	The students can work technical assignments in small	I groups and present the combined	results in the tu	utorial
	-			
	The students are able to carry out practical lab wor	k in small groups and organize a	functional divisi	on of labor between
	them. They are able to discuss their results and to do	cument them scientifically in a rep	ort.	
Autonomy	The students are capable to obtain the needed inform	nation from suitable sources by the	mselves and ass	sess their quality
	The students can proof the state of their knowledge.	•		
	learning process			-
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	120 minutes; theoretical questions and calculations			
scale	,			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineerin	ng: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester			ry
_	General Engineering Science (German program, 7 semester			-
	Bioprocess Engineering: Core Qualification: Compulsory	~	-	
	Energy and Environmental Engineering: Core Qualification: (Compulsory		
	General Engineering Science (English program, 7 semester)	: Specialisation Process Engineerin	g: Compulsory	
	General Engineering Science (English program, 7 semester)	: Specialisation Bioprocess Enginee	ering: Compulsor	y
	General Engineering Science (English program, 7 semester)	Specialisation Energy and Enviror	nental Engineeri	ng: Compulsory
	Process Engineering: Core Qualification: Compulsory			

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

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

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

Course L1159: Separation Pro	cesses	
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.	
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 colloquium	
Content	takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and	
	fellow students.	
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They	
	receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can	
	increase their capabilities in this area.	
	Topics of the practical course:	
	Introduction in the thermal process engineering and to the main features of separation processes	
	Simple equilibrium processes, several steps processes Distillation of binary michana anthology contention discusses.	
	 Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation 	
	Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram	
	Multiphase separation including complex mixtures	
	Designing of separation devices without discrete stages	
	Designing of separation devices without distrete 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 Liking Constanting Processor, McConstalling 2000	
	J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Gathler Thermicals Tournes follows WGL Weight in 1995	
	 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	
	L	

Title Chemical Reaction Engineering (Fundamentals) (L0204) Lecture 2 2 Experimental Course Chemical Engineering (Fundamentals) (L0244) Recitation Section (large) 2 2 Experimental Course Chemical Engineering (Fundamentals) (L0221) Practical Course 2 2 Module Responsible Prof. Raimund Horn Admission Requirements None Recommended Previous Knowledge Methods for engineers. Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge **Engineering** **Engineering** **Skills** After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - determine and compute stable operation points for these reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Independent Study Time 96, Study Time in Lecture 84 Examination duration and Examination duration and Examination d	Module M0892: Chem	ical Reaction Engineering			
Chemical Reaction Engineering (Fundamentals) (L0204) Lecture 2 2 Chemical Reaction Engineering (Fundamentals) (L0244) Rectation Section (large) 2 2 Experimental Course Chemical Engineering (Fundamentals) (L0221) Practical Course 2 2 2 Module Responsible Admission Requirements Rome Recommended Previous Knowledge Knowledge After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Muritien exam	Courses				
Chemical Reaction Engineering (Fundamentals) (L0244) Experimental Course Chemical Engineering (Fundamentals) (L0221) Module Responsible Prof. Raimund Horn Admission Requirements None Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to soil issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Written exam Examination Written exam	Title		Тур	Hrs/wk	СР
Experimental Course Chemical Engineering (Fundamentals) (L0221) Practical Course 2 2 Module Responsible Pof. Raimund Horn Admission Requirements Recommended Previous Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+II as well as computation methods for engineers. Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences betwee thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and we their teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination duration and 120 min	Chemical Reaction Engineering (Fu	ndamentals) (L0204)	Lecture	2	2
Module Responsible Prof. Raimund Horn Admission Requirements Recommended Previous Knowledge methods for engineers. After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to soi issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Credit points Examination Examination duration and	Chemical Reaction Engineering (Fu	ndamentals) (L0244)	Recitation Section (large)	2	2
Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Credit points Examination Written exam Examination duration and	Experimental Course Chemical Eng	ineering (Fundamentals) (L0221)	Practical Course	2	2
Recommended Previous Knowledge methods for engineers. Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Credit points Written exam Examination duration and Examination duration and	Module Responsible	Prof. Raimund Horn			
## Educational Objectives After taking part successfully, students have reached the following learning results ## Professional Competence Knowledge ## Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. ## Skills Skills ## After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. ### Personal Competence ### Social Competence ### Social Competence ### Autonomy ### Autonomy ### Autonomy ### Morkload in Hours ### Independent Study Time 96, Study Time in Lecture 84 ### Credit points ### Written exam ### Examination duration and ### Independent Study Time 96, Study Time in Lecture 84 ### Credit points ### Examination duration and #### Independent Study Time 96, Study Time in Lecture 84 ### Examination duration and #### Independent Study Time 96, Study Time in Lecture 84 #### Examination duration and #### Independent Study Time 96, Study Time in Lecture 84 #### Independent Study Time 96, Study Time in Lecture 84 #### Independent Study Time 96, Study Time in Lecture 84 #### Independent Study Time 96, Study Time in Lecture 84 #### Independent Study Time 96, Study Time in Lecture 84 ###### Independent Study Time 96, Study Time in Lecture 84 ######### Independent Study Time 96, Study Time in Lecture 84 ###################################	Admission Requirements	None			
Educational Objectives Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy Autonomy Written exam be to obtain further information and assess their relevance autonomously. Students can apply the knowledge in the students study Time 96, Study Time in Lecture 84 Examination Written exam Examination duration and After students are able to explain basic concepts of chemical reaction engineering. The students have a strong ability to outline parts of isothermal and non-isothermal and non-isot	Recommended Previous	Contents of the previous modules mathematics I-III, μ	physical chemistry, technical thermod	ynamics I+II as w	vell as computational
Professional Competence Knowledge The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Examination duration and	Knowledge	methods for engineers.			
The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences betwee thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Examination duration and	Educational Objectives	After taking part successfully, students have reached t	the following learning results		
thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isotherm ideal reactors and to describe their properties. Skills After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Written exam	Professional Competence				
ideal reactors and to describe their properties. After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Written exam Examination duration and 120 min	Knowledge	The students are able to explain basic concepts of ch	emical reaction engineering. They are	able to point out	differences between
After successful completion of the module, students are able to:		thermodynamical and kinetical processes. The stude	nts have a strong ability to outline p	arts of isotherma	l and non-isothermal
- apply different computational methods to dimension isothermal and non-isothermal ideal reactors, - determine and compute stable operation points for these reactors, - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination duration and 120 min		ideal reactors and to describe their properties.			
- determine and compute stable operation points for these reactors , - conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Credit points Examination duration and 120 min	Skills	After successful completion of the module, students an	re able to:		
- conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines. Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination duration and 120 min		- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,			
Personal Competence Social Competence After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to sol issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Written exam Examination duration and		- determine and compute stable operation points for the	nese reactors ,		
After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solissues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowledge discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination duration and 120 min		- conduct experiments on a lab-scale pilot plants and o	document these according to scientific	guidelines.	
issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and witheir teachers. Autonomy The students are able to obtain further information and assess their relevance autonomously. Students can apply the knowldege discretely to plan, prepare and conduct experiments. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points Examination Written exam 120 min	Personal Competence				
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	Examination	Written exam			
scale	Examination duration and	120 min			
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Assignment for the General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory	Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Process Enginee	ring: Compulsory	
Following Curricula General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	Following Curricula	General Engineering Science (German program, 7 sem	nester): Specialisation Bioprocess Engir	neering: Compulso	ory
Bioprocess Engineering: Core Qualification: Compulsory		Bioprocess Engineering: Core Qualification: Compulsor	у		
Bioprocess Engineering: Core Qualification: Compulsory		Bioprocess Engineering: Core Qualification: Compulsor	у		
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory		General Engineering Science (English program, 7 seme	ester): Specialisation Process Engineer	ing: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory		General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Engin	eering: Compulso	ry
Process Engineering: Core Qualification: Compulsory		Process Engineering: Core Qualification: Compulsory			
Process Engineering: Core Qualification: Compulsory		Process Engineering: Core Qualification: Compulsory			

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

half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with preequilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

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

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

Literature

lecture notes Raimund Horn

skript Frerich Keil

Rooks

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

reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

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

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

Literature

lecture notes Raimund Horn

skript Frerich Keil

Books:

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- 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
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch
Language	DE/EN
Cycle	SoSe
Content	Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors:
	* Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate
	*CSTR - Residence time distribution, reaction
	*CSTR in Series - Residence time distribution, reaction
	* Plug Flow Reactor - Residence time distribution, reaction
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.
Literature	Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
	Praktikumsskript
	Skript Chemische Verfahrenstechnik 1 (F.Keil)

Title Suppress Regineering - Advanced (13107)	Module M0945: Biopr	ocess Engineering - Advanced			
Bioprocess Engineering - Advanced (1.1018) Reclation Section (small) Port An-Ping Zeng Admission Requirements: Recommended Previous Knowledge Recommended Previous Content of mobile "Biochemical Engineering 1" Recommended Previous Recommended Recommend	Courses				
Modula Responsible Prof. An-Pring Zeng	Title		Тур	Hrs/wk	СР
Module Responsible Admission Requirements None Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge After taking part successfully, students have reached the following learning results Professional Competence Knowledge After successful completion of this module, students should be able to describe and explain important downstreaming steps for proteins and their application as well as basic immobilizate methods - to identify scientific questions or possible practical problems for concrete industrial applications (eg cultivation microorganisms and animal cells) and to formulate solutions To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic, aerobic or microorganisms and to the total fermentation process qualitatively - to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions , - To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of thehavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the calculate immobilization of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Personal Competence Alter completion of this module participants are able				2	
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Professional Competence Knowledge After successful completion of this module, students should be able to • describe and explain different kinetic approaches for growth and substrate-uptake • identification of scientific problems with concrete industrial use (cultivation of microorganisms and mammalian cells) • describe and explain important downstreaming steps for proteins and their application as well as basic immobilizate methods Skills Skills After successful completion of this module, students should be able to • to identify scientific questions or possible practical problems for concrete industrial applications (eg cultivation microorganisms and animal cells) and to formulate solutions. • To identify scientific question of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic, aerobic or microaerobically) • to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions, • To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively • Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, • to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours • describe and expla	-	After taking part successfully, students have reach	hed the following learning results		
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describe and explain important downstreaming steps for proteins and their application as well as basic immobilization methods After successful completion of this module, students should be able to to identify scientific questions or possible practical problems for concrete industrial applications (eg cultivation microorganisms and animal cells) and to formulate solutions, To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic, aerobic or microaerobically) to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions, To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Examination Examination duration and Scale Assignment for the Foliowing Curriculal Bioprocess Engineering: Core Qualification: Compulsory		describe and explain different kinetic appro	paches for growth and substrate-uptake		
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- to identify scientific questions or possible practical problems for concrete industrial applications (eg cultivation microorganisms and animal cells) and to formulate solutions , - To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic, aerobic or microaerobically) - to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions , - To describe the effects of the energy generation, the regeneration of reduction equivalents , and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields , - to select process control strategies (batch , fed-batch , continuity) appropriately and to calculate basic types and evaluate the sacial Competence - Social Competence - Social Competence - After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. - Autonomy - After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. - Workload in Hours - Independent Study Time 124, Study Time in Lecture 56 - Credit points - 6 - Examination - Examination - Written exam - 90 min - General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory - Bioprocess Engineering: Compulsory		· · ·	eaming steps for proteins and their applica	ation as well as	basic immobilization
microorganisms and animal cells) and to formulate solutions , - To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic , aerobic or microaerobically) - to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions , - To describe the effects of the energy generation, the regeneration of reduction equivalents , and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields , - to select process control strategies (batch , fed-batch , continuity) appropriately and to calculate basic types and evaluate the stake position to their own opinions and increase their capacity for teamwork. - Autonomy After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. - Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. - Workload in Hours Independent Study Time 124, Study Time in Lecture 56 - Examination Examination duration and scale Assignment for the Following Curricula Assignment for the Following Curricula - Following Curricula - Examination General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	Skills	After successful completion of this module, studer	nts should be able to		
- To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to give problems (anaerobic, aerobic or microaerobically) - to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions, - To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the selection of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale Assignment for the Following Curricula General Engineering: Core Qualification: Compulsory Following Curricula		- to identifiy scientific questions or possible	practical problems for concrete indust	rial applications	(eg cultivation of
problems (anaerobic, aerobic or microaerobically) - to formulate questions for the analysis and optimization of real biotechnological production processes appropriate solutions, - To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the solicity of the select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the sake position to their own opinions and increase their capacity for teamwork. After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours Credit points 6 Examination Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory					
- To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of a behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the solution of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previoun unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Examination Examination Examination duration and scale Assignment for the General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory				s and to apply th	nese criteria to given
behavior of microorganisms and to the total fermentation process qualitatively - Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and calculate immobilization and activity yields, - to select process control strategies (batch, fed-batch, continuity) appropriately and to calculate basic types and evaluate the Social Competence Social Competence After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previou unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination Written exam 90 min Examination duration and Scale Assignment for the Following Curricula Bioprocess Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory		- to formulate questions for the analysis and optin	nization of real biotechnological production	processes approp	oriate solutions ,
calculate immobilization and activity yields ,				ts , and the gro	wth inhibition of the
Personal Competence Social Competence After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory			solve them to determine the kinetic param	neters of differen	t approaches and to
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability take position to their own opinions and increase their capacity for teamwork. Autonomy After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam 90 min Scale Assignment for the Following Curricula General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory		- to select process control strategies (batch , fed-t	oatch , continuity) appropriately and to cald	culate basic type	s and evaluate them
unknown issues and to present these. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination Written exam Examination duration and scale Assignment for the Following Curricula Bioprocess Engineering: Core Qualification: Compulsory	-	· · · ·	·	small teams to e	nhance the ability to
Credit points 6 Examination Written exam Examination duration and scale Assignment for the Following Curricula Bioprocess Engineering: Core Qualification: Compulsory	Autonomy	· · · ·	ble to aquire new sources of knowledge an	d apply their kno	wledge to previously
Examination Written exam Examination duration and scale Assignment for the Following Curricula Bioprocess Engineering: Core Qualification: Compulsory	Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Examination duration and scale Assignment for the Following Curricula Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory					
Assignment for the Following Curricula General Engineering: Core Qualification: Compulsory Following Curricula Bioprocess Engineering: Core Qualification: Compulsory					
Following Curricula Bioprocess Engineering: Core Qualification: Compulsory		90 min			
	Assignment for the			eering: Compulso	ory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	Following Curricula	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engine	ering: Compulso	ry

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

Course L1108: Bioprocess En	rainoavina - Advancad
•	Recitation Section (small)
Hrs/wk	
CP CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. An-Ping Zeng, Prof. Andreas Liese
Language	
Cycle	
Content	
Literature	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013
	Skripte für die Vorlesung

Module M1275: Enviro	onmental Technology				
Courses					
Title		Тур	Hrs/wk	СР	
Practical Exercise Environmental Technology (L1387)		Practical Course	1	1	
Environmental Technologie (L0326) Lecture			2	2	
Module Responsible	Prof. Martin Kaltschmitt				
Admission Requirements	None				
Recommended Previous	Fundamentals of inorganic/organic chemistry and biolo	ogy			
Knowledge					
Educational Objectives	After taking part successfully, students have reached t	the following learning results			
Professional Competence					
Knowledge	With the completion of this modul the students obtain	profound knowledge of environme	ntal technology. They	are able to describe	
	the behaviour of chemicals in the environment. Stude	ents can give an overview of scient	tific disciplines involve	ed. They can explain	
	terms and allocate them to related methods.				
Skille	Students are able to propose appropriate management	ant and mitigation measures for a	nuironmontal problem	as Thoy are able to	
SKIIIS	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to				
	determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present				
	and defend these opinions in front of and against the group.				
Personal Competence					
Social Competence	The students are able to discuss the various technical	and scientific tasks, both subject-s	pecific and multidiscip	olinary. They are able	
	to develop different approaches to the task as a group	as well as to discuss their theoret	ical or practical impler	mentation.	
Autonomy	Students can independently exploit sources about of the	he subject, acquire the particular k	nowledge and tranfer	it to new problems.	
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Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
Credit points	3				
Examination	Written exam				
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Energy and E	Enviromental Engineer	ring: Compulsory	
Following Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engi	neering: Elective Com	pulsory	
	General Engineering Science (German program, 7 sem	ester): Specialisation Bioprocess E	ngineering: Elective C	Compulsory	
	Bioprocess Engineering: Core Qualification: Elective Co	ompulsory			
	Energy and Environmental Engineering: Core Qualifica	tion: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Energy and E	nviromental Engineeri	ing: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engir	eering: Elective Comp	oulsory	
	General Engineering Science (English program, 7 seme		igineering: Elective Co	ompulsory	
	Process Engineering: Core Qualification: Elective Comp	pulsory			

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

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

	duction to Control Systems				
Courses					
Title	Typ	Hrs/wk CP			
Introduction to Control Systems (LC Introduction to Control Systems (LC					
Module Responsible					
Admission Requirements	 				
-	Representation of signals and systems in time and frequency domain, Laplace tra	ansform			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning result	ts			
Professional Competence					
Knowledge	Students can represent dynamic system behavior in time and frequency d	domain, and can in particular explain properties			
	 first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus 				
	They can explain the Nyquist stability criterion and the stability margins de They can explain the role of the phase margin in analysis and synthesis of				
	They can explain the way a PID controller affects a control loop in terms of	its frequency response			
	They can explain issues arising when controllers designed in continuous tire.	me domain are implemented digitally			
Skills	Students can transform models of linear dynamic systems from time to free	quency domain and vice versa			
	They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of he wight (Ziegler Nichele).	tuning gulos			
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) They can analyze and synthesize simple control loops with the help of root	-			
	They can calculate discrete-time approximations of controllers design.				
	implementation				
Porconal Commeter	They can use standard software tools (Matlab Control Toolbox, Simulink) fo	or carrying out these tasks			
Personal Competence	Students can work in small groups to jointly solve technical problems, and experi	montally validate their controller decigns			
	Students can obtain information from provided sources (lecture notes, software				
riatoriomy	when solving given problems.	e documentation, experiment galacs, and use			
	They can assess their knowledge in weekly on-line tests and thereby control their	r learning progress.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Examination	Written evam				
· · · · · · · · · · · · · · · · · · ·	Witten exam				
Examination duration and	120 min				
scale	120 min				
scale Assignment for the	120 min General Engineering Science (German program, 7 semester): Specialisation Comp				
scale Assignment for the	120 min General Engineering Science (German program, 7 semester): Specialisation Comp General Engineering Science (German program, 7 semester): Specialisation Biopr	rocess Engineering: Compulsory			
scale Assignment for the	120 min General Engineering Science (German program, 7 semester): Specialisation Comp General Engineering Science (German program, 7 semester): Specialisation Biopr General Engineering Science (German program, 7 semester): Specialisation Nava	rocess Engineering: Compulsory Il Architecture: Compulsory			
scale Assignment for the	120 min General Engineering Science (German program, 7 semester): Specialisation Comp General Engineering Science (German program, 7 semester): Specialisation Biopr General Engineering Science (German program, 7 semester): Specialisation Nava General Engineering Science (German program, 7 semester): Specialisation Civil II	rocess Engineering: Compulsory al Architecture: Compulsory Engineering: Compulsory			
scale Assignment for the	120 min General Engineering Science (German program, 7 semester): Specialisation Comp General Engineering Science (German program, 7 semester): Specialisation Biopr General Engineering Science (German program, 7 semester): Specialisation Nava	rocess Engineering: Compulsory al Architecture: Compulsory Engineering: Compulsory crical Engineering: Compulsory			
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scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Comp General Engineering Science (German program, 7 semester): Specialisation Biopr General Engineering Science (German program, 7 semester): Specialisation Nava General Engineering Science (German program, 7 semester): Specialisation Civil I General Engineering Science (German program, 7 semester): Specialisation Electr General Engineering Science (German program, 7 semester): Specialisation Biom General Engineering Science (German program, 7 semester): Specialisation Energy General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory	rocess Engineering: Compulsory al Architecture: Compulsory Engineering: Compulsory crical Engineering: Compulsory dedical Engineering: Compulsory gy and Enviromental Engineering: Compulsory ess Engineering: Compulsory on Mechanical Engineering, Focus Mechatronical and Mechanical Engineering, Focus Biomechanical			
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	co Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus plots Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools
	Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0539: Proce	ss and Plant Engineering I				
Courses					
Title		Тур	Hrs/wk	СР	
Process and Plant Engineering I (L0095)		Lecture	2	2	
Process and Plant Engineering I (L0096)		Recitation Section (large)	1	2	
Process and Plant Engineering I (L1214)		Recitation Section (small)	1	2	
Module Responsible	Prof. Georg Fieg				
Admission Requirements	None				
Recommended Previous	unit operation of thermal an dmechanical separation process	ses			
Knowledge	chemical reactor eingineering				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results			
Professional Competence					
Knowledge	students can:				
	classify and formulate blobal balance equations of chemical	processes			
	specify linear component equations of complex chemical pro	ocesses			
	explain linear regression and data reconcilliation problems				
	explain pfd-diagrams				
Skills	students are capable of				
	- formulation of mass and energy balance equations and estimation of product streams				
	- estimation of component streams of chemical plants using linear component balance models				
	- solution of data reconcilliation tasks				
	- conduction of process synthesis				
	- economic evaluation of processes and the estimation of pro	oduction costs			
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
	Written exam				
Examination duration and scale	120 Min. lectures notes and books				
Assignment for the	General Engineering Science (German program, 7 semester)	· Specialisation Process Engineer	ing: Compulsory		
Following Curricula	General Engineering Science (German program, 7 semester)			nrv	
	General Engineering Science (German program, 7 semester)			-	
	Compulsory	5, 1		J 11 J 11	
	Bioprocess Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering	ng: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engine	ering: Compulsor	ry	
	General Engineering Science (English program, 7 semes Compulsory	ter): Specialisation Energy and	Enviromental E	ingineering: Elective	
	Process Engineering: Core Qualification: Compulsory				
	gg q.aameadom company				

T	Leekure		
	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
en_mh_head_studienleistung	none		
Lecturer	Prof. Georg Fieg		
Language	DE		
Cycle	SoSe		
Content	1. Introduction		
	Structure and operation of production plants		
	Operational business process		
	Technical process design		
	Motivation and targets of process development		
	Life cycle of production plants		
	2. Engineering methods and tools		
	Mass and energy balances		
	Strategies of process synthesis		
	Graphical representation of processes		
	Multidimensional regression		
	Data reconciliation and data validation		

	3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation
Literature	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
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	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
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	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
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	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
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	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
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	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
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	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

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

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

Module M0670: Partic	cle Technology and Solids Process	Engineering					
Courses							
Title		Тур		Hrs/wk	СР		
Particle Technology I (L0434)	Lecture 2 3						
Particle Technology I (L0435)	Recitation Section (small) 1 1						
Particle Technology I (L0440)	Practical Course 2 2						
Module Responsible	Prof. Stefan Heinrich						
Admission Requirements	None						
Recommended Previous	keine						
Knowledge							
Educational Objectives	After taking part successfully, students have read	hed the following learning re	sults				
Professional Competence							
Knowledge	After successful completion of the module studer	its are able to					
	 name and explain processes and unit-ope 	rations of solids process engi	neering				
	characterize particles, particle distribution		-				
Skills	Students are able to						
	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						
	document their work scientifically.						
Personal Competence							
Social Competence	The students are able to discuss scientific topi	cs orally with other students	or scientific pe	rsonal and to d	levelop solutions for		
	technical-scientific issues in a group.						
Autonomy	- '						
		ure 70					
	Written exam						
Examination duration and	90 minutes						
scale							
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory						
Following Curricula	General Engineering Science (German program,				-		
	General Engineering Science (German program,		nergy and Enviror	mental Engineer	ring: Compulsory		
	Bioprocess Engineering: Core Qualification: Comp	•					
	Energy and Environmental Engineering: Core Qua						
	General Engineering Science (English program, 7						
	General Engineering Science (English program, 7				-		
	General Engineering Science (English program, 7		ergy and Environ	nental Engineeri	ing: Compulsory		
	Process Engineering: Core Qualification: Compuls	огу					

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

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

Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882) Introduction to Management (L088	30)	Recitation Section (large) Lecture	2 3	3
Module Responsible			-	-
Admission Requirements	·			
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important ba and Organisation to Marketing and Innovation, and also to			
	explain the differences between Economics and important definitions from the field of Management explain the most important aspects of and goals projects describe and explain basic business functions a organization and human ressource management, in explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and selection.	n Management and name the mos s production, procurement and s formation management, innovation making in Business, esp. in situa mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain manageme nd marketing
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular, the		ojectives, strateg	ies etc.) and to ca
	analyse Management goals and structure them app analyse organisational and staff structures of comp apply methods for decision making under multiple analyse production and procurement systems and analyse and apply basic methods of marketing select and apply basic methods from mathematical apply basic methods from accounting, costing and	anies objectives, under uncertainty and un Business information systems finance to predefined problems	nder risk	
Personal Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an ent to communicate appropriately and to cooperate respectfully with their fellow students Students are able to work in a team and to organize the team themselve to write a report on their project.		oherent report on	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	, ,			
-	Subject theoretical and practical work			
	several written exams during the semester			
scale	-			
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula	General Engineering Science (German program, 7 semest General Engineering Science (German program, 7 semest Compulsory General Engineering Science (German program, 7 semest Compulsory	er): Specialisation Biomedical Engin er): Specialisation Naval Architectur er): Specialisation Computer Science er): Specialisation Bioprocess Engin er): Specialisation Civil Engineering: er): Specialisation Energy and Envir mester): Specialisation Mechanica mester): Specialisation Mechanica	eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory compulsory omental Enginee I Engineering, I	ory ring: Compulsory Focus Mechatroni Focus Biomechani
	Engineering: Compulsory General Engineering Science (German program, 7 s Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest and Production: Compulsory	emester): Specialisation Mechanic	al Engineering,	Focus Materials
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical I	Engineering, Foc	us Energy Syste

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

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

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

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

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

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

General Engineering Science (Engini program, 7 semester). Specialisation bioprocess Engineering, Compulso

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP 3

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Lecturer Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek

Language DE

Cycle WiSe/SoSe

Content

In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.

If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on se selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction t	o Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
	WiSe/SoSe
	WISC, SOC
Content	 Introduction to 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.

Module M1274: Enviro	onmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
	With the completion of this module the students acqui environmental problems which might occur from production about the methodological diversity and are competent in compacts. Besides the students are able to estimate the condifficulties with their measurement.	on processes, projects or constructi dealing with different methods and i mplexity of these environmental pro	on measures. T nstruments to a ocesses as well	hey have knowledge ssess environmental as uncertainties and
Skills	The students are able to select a suitable method for the can develop suitable solutions for managing and mitigatin out Life Cycle Impact Assessments independently and ca After finishing the course the students have the compenvironmental impacts.	g environmental problems in a busi n apply the software programs Op	ness context. The enLCA and the	hey are able to carry database Ecolnvent.
Personal Competence				
Social Competence	The students are able to discuss the various technical and to develop jointly different solutions and to discuss thei topics, the students receive insights into the multi-layered Their sensitivity and consciousness towards these subject social responsibilities in their role as engineers.	r theoretical or practical implement issues of the environment protection	tation. Due to on and the cond	the selected lecture ept of sustainability.
Autonomy	The students learn to research, process and present a s scientific work. They can solve an environmental problem i			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and	1 hour written exam			
scale				
_	General Engineering Science (German program, 7 semeste		_	
Following Curricula	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste Bioprocess Engineering: Core Qualification: Elective Compu		ig. Elective Com	1µu1501 y
	Bioprocess Engineering: Core Qualification: Elective Compt	•		
	Energy and Environmental Engineering: Core Qualification:	,		
	General Engineering Science (English program, 7 semester		nental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Enginee	ring: Elective Co	ompulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering	g: Elective Comp	oulsory
	Process Engineering: Core Qualification: Elective Compulso			
	Process Engineering: Core Qualification: Elective Compulso	ry		

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

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

Specialization 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: Electr	ical Engineering III: Circuit Theory and Transients
Courses	
Title Circuit Theory (L0566) Circuit Theory (L0567)	Typ Hrs/wk CP Lecture 3 4 Recitation Section (small) 2 2
Module Responsible Admission Requirements	Prof. Arne Jacob None
-	Electrical Engineering I and II, Mathematics I and II
Knowledge	Eccarcal Engineering Faira II, Natherhades Faira II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to explain the basic methods for calculating electrical circuits. They know the Fourier series analysis of line networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequen domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.
Skills	The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain t respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-termina circuits.
Davisanal Commetence	
Personal Competence	Students work on exercise tasks in small guided groups. They are encouraged to present and discuss their results within t
Joelal Competence	group.
Autonomy	The students are able to find out the required methods for solving the given practice problems. Possibilities are given to test the knowledge during the lectures continuously by means of short-time tests. This allows them to control independently the educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Examination	Written exam
Examination duration and	
scale	
Assignment for the	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Electrical Engineering: Core Qualification: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory Mechatronics: Core Qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

	Hrs/wk	СР
	3	4
n Section (small)	1	2
on of the module's ex	xamination acco	rding to the following
us on the examination vely, up to the next-benchmark not possible.		o the successful labs
ng results		
ig results		
This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-leprogramming down to gates. The module includes the following topics: • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design		
and division cycle architecture, p sing data, point-to-po		i, busses
e, i.e., they identify the specific and individual etween and to explacessors.	al computers ca	n be built based on a
dge the interdepende and the consequence down to gates. This w erformance and to pr	es that the exec way, they will be	cution of software had e enabled to evaluate
esent the results acco	ordingly.	
o associate this know	wledge with othe	er classes.
oulsory on Computer Science on Bioprocess Engine on Naval Architecture on Civil Engineering: on Electrical Engineer on Biomedical Engine on Energy and Enviro on Process Engineerin	eering: Compuls e: Compulsory Compulsory vring: Compulsor eering: Compuls omental Enginee ng: Compulsory	y ory ering: Compulsory
	Engineering, Fo Engineering, Fo al Engineering, Deering, Focus To Eneering, Focus	Focus Biomechanics cus Aircraft System Focus Materials in heoretical Mechanica Product Developmen
sa		n Mechanical Engineering, Focus ition Mechanical Engineering, Foc sory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

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

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

Module M0567: Theor	etical Electrical Engineering I: Time	e-Independent Fields		
Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I:	•	Lecture	3	5
Theoretical Electrical Engineering I:	Time-Independent Fields (L0181)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	None			
	Basic principles of electrical engineering and advan	ced mathematics		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students can explain the fundamental formulas, re	lations, and methods of the theory of time	e-independent el	ectromagnetic fields.
	They can explicate the principal behavior of elec-	trostatic, magnetostatic, and current den	sity fields with	regard to respective
	sources. They can describe the properties of com	plex electromagnetic fields by means of	superposition of	solutions for simple $% \label{eq:continuous} % \[\left($
	fields. The students are aware of applications for the	ne theory of time-independent electromag	netic fields and	are able to explicate
	these.			
CL:III-	Chalanta and analy Managella Facations in in	beauting to reduce the reliant		Marie de de constant
SKIIIS	Students can apply Maxwell's Equations in in electromagnetic field problems. Furthermore, they			•
	Equations for more general problems. The students			-
	analyze these quantitatively. They can deduce mea			
	electrical flow fields (capacitances, inductances, res			
Personal Competence				
_	Students are able to work together on subject relat	ed tasks in small groups. They are able to	nresent their re	sults effectively (e.g.
Social Competence	during exercise sessions).	ed tasks in small groups. They are able to	present then re	suits effectively (e.g.
Autonomy	Students are capable to gather necessary informati			
	able to continually reflect their knowledge by mean			
	lectures and exercises that are related to the exam			
	learning process. They are able to draw connection lectures (e.g. Electrical Engineering I, Linear Algebra		uns recture and	the content of other
	receases (e.g. Electrical Engineering I, Elliedi Algebi	a, and Analysis).		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and	90-150 minutes			
Scale	General Engineering Science (German program): Sp	ocialisation Floctrical Engineering, Carrette	lcon/	
Following Curricula	General Engineering Science (German program): Sp. General Engineering Science (German program, 7 s	- ·	-	1
. onewing curricula	Electrical Engineering: Core Qualification: Compulso	- · ·	g. compuisor	,
	General Engineering Science (English program): Spe	•	sory	
	General Engineering Science (English program, 7 se	·	-	
	Computational Science and Engineering: Specialisat			
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		

Course L0180: Theoretical El	ectrical Engineering I: Time-Independent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster, Prof. Frank Gronwald
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
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	ectrical Engineering I: Time-Independent Fields
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Schuster
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
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Module M0748: Mater	ials in Electrical Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Electrotechnical Experiments (L0714)		Lecture	1	1
Materials in Electrical Engineering (L0685)		Lecture	2	3
Materials in Electrical Engineering (F	(Problem Solving Course) (L0687) Recitation Section (small) 2 2			2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous	Highschool level physics and mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students can explain the composition and the structu	ral properties of materials used in	electrical engine	eering. Students can
	explicate the relevance of mechanical, electrical, therma	l, dielectric, magnetic and chemical	properties of mat	erials in view of their
	applications in electrical engineering.			
Chille				
	Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solutions and judge factors influential on the performance of materials in electrical engineering applications.			
	and judge factors influential on the performance of mate	rials in electrical engineering applica	ations.	
Personal Competence				
, and the second	Students can jointly solve subject related problems in gro	oups. They can present their results	effectively within	the framework of the
	problem solving course.			
-	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 exam			
	typical exam questions. Students are able to connect the	ir knowledge with that acquired fror	n other lectures.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German program): Special	isation Electrical Engineering: Comp	ulsory	
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Engine	ering: Compulsory	/
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialis	sation Electrical Engineering: Compu	lsory	
	General Engineering Science (English program, 7 semest	er): Specialisation Electrical Enginee	ering: Compulsory	
	Computational Science and Engineering: Specialisation E	ngineering Sciences: Elective Comp	ulsory	

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

Typ Lecture Hrs/wk 2 CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Manfred Eich Language DE Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition. Symmetries, conserved quantities, and the labeling of states.	
CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Manfred Eich Language DE Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Manfred Eich Language DE Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Lecturer Prof. Manfred Eich Language DE Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Language DE Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Cycle SoSe Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Content The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
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Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition.	
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	
Tagricus domains	
Literature 1.Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials,	
Massachusetts Institute of Technology (MIT), 2013	
2.Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004	
3.Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994	
4.Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994	
5.Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979	
6.Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004	
7.Ashcroft, Mermin, Solid State Physics, Harcourt, 1976	
8.Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988	
9.Sze, Physics of Semiconductor Devices, Wiley, 1981	
10.Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007	
11. Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2008	
12.Handley, Modern Magnetic Materials, Wiley, 2000	
13.Wikipedia, Wikimedia	

Course L0687: Materials in Electrical Engineering (Problem Solving Course)	
Тур	Recitation Section (small)
Hrs/wk	2
СР	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)

Module M0672: Signa	ils 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 and sy		-	
	1-3 is expected. Further experience with spectral transform	nations (Fourier Series, Fourier tra	ansform, Lapiace	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the fo	lowing learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and	inear time-invariant (LTI) systems	using methods	of signal and system
	theory. They are able to apply the fundamental transforma	tions of continuous-time and disc	rete-time signal	s and systems. They
	can describe and analyse deterministic signals and system			
	understand the effects in time domain and image domain	which are caused by the transit	tion of a continu	ious-time signal to a
	discrete-time signal.			
Skills	The students are able to describe and analyse deterministic	signals and linear time-invariant	systems using n	nethods of signal and
	system theory. They can analyse and design basic syst			
	response, stability, linearity etc They can assess the impact	t of LTI systems on the signal pro	perties in time a	nd frequency domain.
Personal Competence				
•	The students can jointly solve specific problems.			
Autonomy		rom appropriate literature source	es. They can d	control their level of
7.acoomy	knowledge during the lecture period by solving tutorial prob		-	10101 01
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	,		
Credit points				
	Written exam			
Examination duration and				
scale	90 111111			
	Congret Engineering Science (Correspondence): Congreta	ion Floring Fraincering, Comm	leen.	
Assignment for the				
Following Curricula	General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisal	- ·	-	
	General Engineering Science (German program): Specialisat			ory
	General Engineering Science (German program): Specialisat			ory
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester			v
	General Engineering Science (German program, 7 semester			,
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 semester			orv
	General Engineering Science (German program, 7 semester			-
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanica	I Engineering, I	Focus Biomechanics:
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical I	Engineering, Foo	us Energy Systems:
	Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineering, Fo	cus Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program, 7 sen	nester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanica	I Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechanical
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisati			ory
	General Engineering Science (English program): Specialisati		-	
	General Engineering Science (English program): Specialisati		-	
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program): Specialisati		-	
	General Engineering Science (English program): Specialisati		-	,
	General Engineering Science (English program, 7 semester)	•		,
	General Engineering Science (English program, 7 semester)	·		
	General Engineering Science (English program, 7 semester)			m.
	General Engineering Science (English program, 7 semester)			-
	General Engineering Science (English program, 7 semester)			-
	General Engineering Science (English program, 7 seme	ster). Specialisation Mechanical	Engineering, I	ocus bioinechanics:
	Compulsory General Engineering Science (English program 7 semes	tor). Specialisation Machanical F	Engineering Ear	us Engray Systoms
	General Engineering Science (English program, 7 semes	ter). Specialisation Mechanical E	.ngmeering, F00	us cilergy systems:

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Module M0709: Electr	ical Engineering IV: Transmission Line	s and Research Seminar		
Courses				
Title	ering, Computer Science, Mathematics (L0571)	Typ Seminar Lecture	Hrs/wk 2 2	CP 2 3
Transmission Line Theory (L0572)		Recitation Section (large)	2	1
Module Responsible	Prof. Arne Jacob			
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I-III, Mathematics I-III			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students can explain the fundamentals of wave propaga analyze circuits with transmission lines in time and frequ lines. They are able to solve problems with coupled trans	ency domain. They can describe sim	ple equivalent cir	cuits of transmission
Skills	Students can analyze and calculate the propagation of waves in simple circuits with transmission lines. They are able to analyze circuits in frequency domain and with the Smith chart. They can analyze equivalent circuits of transmission lines. They are able to solve problems including coupled transmission lines using the vectorial transmission line equations. They are able to give a talk to professionals.			
Personal Competence				
Social Competence	Students can analyze and solve problems in small group experiments in the lecture and discuss it in small groups with them.	•		•
Autonomy	The students can solve problems by their own and are a test their knowledge using computer animations. They during the lecture. They are able to relate their acque Mathematics I-III). They can familiarize themselves with a	can test their level of knowledge by uired knowledge to other lectures	answering short (e.g. Electrical E	questions and tests
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
	6			
Examination				
	150 min			
scale				
Assignment for the	General Engineering Science (German program): Speciali	sation Electrical Engineering: Comp	ulsory	
Following Curricula	General Engineering Science (German program, 7 semes		-	,
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialis	ation Electrical Engineering: Compu	Isory	
	General Engineering Science (English program, 7 semest	er): Specialisation Electrical Enginee	ering: Compulsory	
	Computational Science and Engineering: Specialisation E	ngineering Sciences: Elective Comp	ulsory	
	Technomathematics: Specialisation III. Engineering Scien	ce: Elective Compulsory		

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

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

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

Module M0854: Matho	ematics IV			
Courses				
Title Differential Equations 2 (Partial Diff Differential Equations 2 (Partial Diff Differential Equations 2 (Partial Diff	ferential Equations) (L1044)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	CP 1 1
Complex Functions (L1038) Lecture 2 1 Complex Functions (L1041) Recitation Section (small) 1 1 Complex Functions (L1042) Recitation Section (large) 1 1			1	
•	Prof. Anusch Taraz None			
Admission Requirements Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence Knowledge	Students can name the basic concepts in Mathem Students can discuss logical connections between the help of examples. They know proof strategies and can reproduce the	n these concepts. They are capable		·
Skills	 Students can model problems in Mathematics IV capable of solving them by applying established n Students are able to discover and verify further lo For a given problem, the students can develop results. 	nethods. gical connections between the conce	pts studied in the	e course.
Personal Competence Social Competence				
Autonomy	 Students are capable of checking their understar precisely and know where to get help in solving the Students have developed sufficient persistence to problems. 	nem.		
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equat	tions 2)		
-	General Engineering Science (German program): Special		-	
Following Curricula	General Engineering Science (German program): Special General Engineering Science (German program): Seguineering: Compulsory General Engineering Science (German program): Special	Specialisation Mechanical Engineer	ing, Focus The	, -
	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 s Compulsory			-
	General Engineering Science (German program, 7 seme: Engineering: Compulsory General Engineering Science (German program, 7 semes		-	neoretical Mechanical
	Computer Science: Specialisation Computational Mathen	•	e. Compuisory	
	Electrical Engineering: Core Qualification: Compulsory	, ,		
	General Engineering Science (English program): Speciali General Engineering Science (English program): Speciali		-	
	General Engineering Science (English program): Speciali General Engineering Science (English program): Speciali General Engineering Science (English program): Speciali Compulsory	sation Mechanical Engineering, Focus	Mechatronics: C	
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 s Compulsory	•		
	General Engineering Science (English program, 7 semes Engineering: Compulsory General Engineering Science (English program, 7 semesi		-	neoretical Mechanical
	Computational Science and Engineering: Specialisation E		Isory	

Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Specialisation Mechatronics: Compulsory
Mechatronics: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Course L1043: Differential E	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
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

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

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

Course L1038: Complex Functions	
Тур	Lecture
Hrs/wk	2
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 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 Fund	ourse L1041: Complex Functions	
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 L1042: Complex Functions	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0675: Introduction to Communications and Random Processes				
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Communications an	d Random Processes (L0442)	Lecture	3	4
Introduction to Communications an	d Random Processes (L0443)	Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	a Mathematica 1 2			
Knowledge	Mathematics 1-3 Gineral and Guntaria			
	Signals and Systems			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students know and understand the fundamental	building blocks of a communications sy	stem. They can d	lescribe and analyse
	the individual building blocks using knowledge of sigr	nal and system theory as well as the th	neory of stochasti	c processes. The are
	aware of the essential resources and evaluation crite	ria of information transmission and are	e able to design a	and evaluate a basic
	communications system.			
Skills	The students are able to design and evaluate a ba	sic communications system. In partic	ular, they can es	stimate the required
	resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications			
	system such as bandwidth efficiency or bit error rate a	and to decide for a suitable transmissio	n method.	
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. Thev can c	ontrol their level of
	knowledge during the lecture period by solving tutoria		-	
	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points				
Examination	Written exam			
Examination duration and	90 min			
scale				
-	General Engineering Science (German program, 7 sem		ering: Compulsory	1
Following Curricula	· · · · · · · · · · · · · · · · · · ·			
	Computer Science: Specialisation Computational Math	' '		
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 sem		ring: Compulsory	
	Computational Science and Engineering: Core Qualific			
	Computational Science and Engineering: Specialisation		ulsory	
	Technomathematics: Specialisation III. Engineering Sc	ience: Elective Compulsory		

Course L0442: Introduction t	o Communications and Random Processes
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	
Cycle	WiSe
Content	Fundamentals of random processes
	Introduction to communications engineering Quadrature amplitude modulation
	Description of radio frequency transmission in the equivalent complex baseband
	Transmission channels, channel models
	Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)
	Fundamentals of information theory, source coding, channel coding
	 Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
	Fundamentals of digital modulation
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner
	P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
	M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
	S. Haykin: Communication Systems. Wiley
	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

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

Module M1235: Electr	rical Power Systems I: Introduction	to Electrical Power Systems	•	
Courses				
*	ction to Electrical Power Systems (L1670) ction to Electrical Power Systems (L1671)	Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous	Fundamentals of Electrical Engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d 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 critically evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment into 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 in			
	front of others.			
Autonomy	Students can independently tap knowledge of the en	nphasis of the lectures.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Electrical Engine	ering: Elective Co	mpulsory
Following Curricula	Electrical Engineering: Core Qualification: Elective C	ompulsory		
	Energy and Environmental Engineering: Specialisation	on Energy Engineering: Elective Compuls	ory	
	Energy and Environmental Engineering: Specialisation	on Energy Engineering: Elective Compuls	ory	
	Energy Systems: Specialisation Energy Systems: Ele			
	General Engineering Science (English program, 7 se		-	
	Computational Science and Engineering: Specialisat			ilsory
	Computational Science and Engineering: Specialisat		ulsory	
	Renewable Energies: Core Qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Comp	, , , , , , , , , , , , , , , , , , , ,		
	Theoretical Mechanical Engineering: Specialisation E	nergy Systems: Elective Compulsory		

Course L1670: Electrical Power Systems I: Introduction to Electrical Power Systems		
Тур	Lecture	
Hrs/wk	3	
СР	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	

Typ Re Hrs/wk 2 CP 2	ecitation Section (large)
CP 2	
Workload in Hours Inc	dependent Study Time 32, Study Time in Lecture 28
Lecturer Pro	rof. Christian Becker
Language DE	E
Cycle Wi	riSe
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
Α.	J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
R.	Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Module M0783: Measi	urements: Methods and Data Pro	cessing			
Courses					
Title		Тур		Hrs/wk	СР
EE Experimental Lab (L0781)		Practio	cal Course	2	2
Measurements: Methods and Data I		Lectur		2	3
Measurements: Methods and Data I	Processing (L0780)	Recita	tion Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer				
Admission Requirements	None				
Recommended Previous	principles of mathematics				
Knowledge	principles of electrical engineering				
Educational Objectives	After taking part successfully, students have rea	ched the following lear	ning results		
Professional Competence					
Knowledge	The students are able to explain the purpose of	f metrology and the ac	quisition and processing	g of measureme	ents. They can detail
	aspects of probability theory and errors, and exp	plain the processing of	stochastic signals. Stud	ents know meth	ods to digitalize and
	describe measured signals.				
Skills	The students are able to evaluate problems of m	netrology and to apply i	methods for describing	and processing o	of measurements.
Personal Competence					
Social Competence	The students solve problems in small groups.				
Autonomi	The shird outs one well out the six knowledge and dis	sauce and auglicate thai	u unaculha		
Autonomy	The students can reflect their knowledge and dis	scuss and evaluate thei	r results.		
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70			
Credit points		10.0 70			
Examination					
Examination duration and					
scale					
Assignment for the	General Engineering Science (German program,	7 semester): Specialisa	ation Electrical Engineer	ing: Elective Co	mpulsory
Following Curricula	Electrical Engineering: Core Qualification: Comp	•	3	_	
•	General Engineering Science (English program, 7	-	tion Electrical Engineeri	ng: Elective Con	npulsory
	Computational Science and Engineering: Special				. ,
	Computational Science and Engineering: Special				
	Technomathematics: Specialisation III. Engineeri		•	,	
		J	F - 2217		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering Theoretical Electrical Engineering		Lecture Recitation Section (small)	3	5 1
		Nectration Section (Smail)	2	1
Admission Requirements	Prof. Christian Schuster None			
Recommended Previous		II Theoretical Electrical Engineering I		
Knowledge	Liectrical Engineering I, Liectrical Engineering	ii, medieticai Electricai Engineering i		
	Mathematics I, Mathematics II, Mathematics III	l, Mathematics IV		
Educational Objectives		eached the following learning results		
Professional Competence		I formaniles relations and mostles de relation	d to the theory	of time demanden
Knowieage	Students are able to explain fundamenta electromagnetic fields. They can assess the p			
	regard to respective sources. They can descr			
	solutions for simple fields. The students are as			
	able to explicate these.			
Skills	Students are able to apply a variety of procedu			
	field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively.			
	They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.			
	vector, radiation resistance, etc.) from given in	leids and interpret them with regard to practic	ат аррпсацопѕ.	
Personal Competence				
Social Competence	Students are able to work together on subject	related tasks in small groups. They are able t	to present their re	sults effectively (e.g
	during exercise sessions).			
Autonomy	Students are capable to gather necessary info			
	able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the			
	lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between acquired knowledge and ongoing research at the Hamburg			
	University of Technology (TUHH), e.g. in the ar	· · · · · · · · · · · · · · · · · · ·	a ongoing resear	rch at the Hamburg
	Similar of recimology (101111), e.g. III tile di	ea of man requeries engineering and optics.		
Workload in Hours	Independent Study Time 110, Study Time in Lo	ecture 70		
Credit points				
Examination	Written exam			
Examination duration and	90-150 minutes			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Electrical Engine	eering: Compulsor	y
Following Curricula		• •		
	Technomathematics: Specialisation III. Engine	ering Science: Elective Compulsory		

Course L0182: Theoretical El	ectrical Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 108, Study Time in Lecture 42
	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 M0760: Electr	ronic Devices			
Courses				
Title Electronic Devices (L0720) Electronic Devices (L0721)	Typ Lecture Project-/problem-based I	Learning	Hrs/wk 3 2	CP 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous				
Knowledge	Successful participation of Physics for Engineers and Materials in Electrical Engineering of	or course	s with equivaler	nt contents
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
	Students are able			
	to represent the basics of semiconductor physics,			
	to explain the operating principle of important semiconductor devices,			
	to outline device characteristics and equivalent circuits as well as to explain their	derivatio	on and	
	to discuss the limitation of device models.			
Skills	Students are capable			
	to apply devices in basic circuits,			
	to realize the physical context and to solve complex problems by oneself			
Downonal Commeters				
Personal Competence Social Competence	Students are able to prepare and perform their lab experiments in team work as well as of audience.	s to prese	ent and discuss	the results in front
Autonomy	Students are capable to acquire knowledge based on literature in order to prepare their	experime	ents.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	1		
Credit points	6			
Examination	Written exam			
	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Electrical En	ngineerin	g: Compulsory	
Following Curricula	Electrical Engineering: Core Qualification: Compulsory	alnossis -	. Compulson:	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Eng Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science			ory

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

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

Courses			
Fitle ntroduction to Control Systems (LC	Typ 0654) Lecture	Hrs/wk 2	CP 4
ntroduction to Control Systems (LC		2	2
Module Responsible			
Admission Requirements	None		
Recommended Previous	Representation of signals and systems in time and frequency domain, Laplace transform		
Knowledge			
	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students can represent dynamic system behavior in time and frequency domain, and can	in particular	explain properties
	first and second order systems		
	They can explain the dynamics of simple control loops and interpret dynamic properties in	terms of freq	luency response ar
	 root locus They can explain the Nyquist stability criterion and the stability margins derived from it. 		
	They can explain the role of the phase margin in analysis and synthesis of control loops		
	They can explain the way a PID controller affects a control loop in terms of its frequency re	esponse	
	They can explain issues arising when controllers designed in continuous time domain are in	mplemented of	digitally
Skills			
	Students can transform models of linear dynamic systems from time to frequency domain	and vice vers	a
	They can simulate and assess the behavior of systems and control loops They can design RID assess they with the last of the writing (7) and a Michael business and a second size of the second size o		
	 They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequ 	iency resnonsi	e techniques
	They can calculate discrete-time approximations of controllers designed in continu		
	implementation		,
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the	hese tasks	
Personal Competence			
	Students can work in small groups to jointly solve technical problems, and experimentally validat	e their contro	ller designs
Autonomy			
			t guides) alla use
	when solving given problems.		t guides) and use
			t guides) and use
	when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progre		t guides) and use
			t guides) and use
			t guides) and use
Workload in Hours	They can assess their knowledge in weekly on-line tests and thereby control their learning progre		t guides) and use
Workload in Hours Credit points	They can assess their knowledge in weekly on-line tests and thereby control their learning progres		t guides) and use
Credit points	They can assess their knowledge in weekly on-line tests and thereby control their learning progres		t guides) and use
Credit points	They can assess their knowledge in weekly on-line tests and thereby control their learning progres Independent Study Time 124, Study Time in Lecture 56 Written exam		t guides) and use
Credit points Examination	They can assess their knowledge in weekly on-line tests and thereby control their learning progres Independent Study Time 124, Study Time in Lecture 56 Written exam		t guides) and use
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

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
	- 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
	- computer based exercises unoughout the course
Literature	
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
i	

Course L0655: Introduction to Control Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0777: Semi	conductor Circuit Design			
Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L07		Lecture	3	4
Semiconductor Circuit Design (L08	64)	Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics, especially semiconductor physics			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	,	3 3		
Knowledge				
	Students are able to explain the functionality of		uits.	
	Students are able to explain how analog circuits			
	Students are able to explain the functionality of			
	Students know the fundamental digital logic circ Students have knowledge about memory circuit			es.
	 Students have knowledge about memory circuit Students know the appropriate fields for the use 		a specifications.	
	Students know the appropriate fields for the use	e of Dipolal Clarisiscors.		
Skills				
	Students can calculate the specifications of difficulty and the specification			ctronic circuits.
	Students are able to develop different logic circ			
	 Students can use MOS devices, operational amp 	differs and dipolar transistors for specif	ic applications.	
Personal Competence Social Competence Autonomy	Students are able work efficiently in heterogene Students working together in small groups can: Students are able to assess their level of knowle	solve problems and answer professiona	l questions.	
	Independent Study Time 124, Study Time in Lecture 5	Ü		
Credit points Examination				
Examination duration and				
scale				
	General Engineering Science (German program, 7 sem	nester): Specialisation Electrical Engine	ering: Compulsor	V
	General Engineering Science (German program, 7 sen			
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	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7	- · ·		
	Compulsory		2 3,	
	Computational Science and Engineering: Specialisation	n II. Mathematics & Engineering Science	e: Elective Compu	ulsory
	Mechanical Engineering: Specialisation Mechatronics:	Compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Sc	ience: Elective Compulsory		

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

Course L0864: Semiconducto	or Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	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: 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/jmg/bo

Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2	3
Module Responsible			-	-
Admission Requirements				
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
	explain the differences between Economics an important definitions from the field of Managemen explain the most important aspects of and goals projects describe and explain basic business functions organization and human ressource management, explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and sele	t in Management and name the mos as production, procurement and s nformation management, innovation making in Business, esp. in situa mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain managemend d marketing
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular,		ojectives, strateg	ies etc.) and to car
	 analyse Management goals and structure them ap analyse organisational and staff structures of com apply methods for decision making under multiple analyse production and procurement systems and analyse and apply basic methods of marketing select and apply basic methods from mathematica apply basic methods from accounting, costing and 	panies objectives, under uncertainty and un Business information systems I finance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an en to communicate appropriately and to cooperate respectfully with their fellow students Students are able to work in a team and to organize the team themselv to write a report on their project.		oherent report on	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and	several written exams during the semester			
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 semes	- ·		ory
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 semes	· · ·		ory
	General Engineering Science (German program, 7 semes			ring: Compulsory
	General Engineering Science (German program, 7 series		_	
	Compulsory		geg,	
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (German program, 7 ser Engineering: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory	ter): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani
	General Engineering Science (German program, 7 seme and Production: Compulsory	ster): Specialisation Mechanical Eng	ineering, Focus F	roduct Developm
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanical I	Engineering, Foc	us Energy Systen

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial
Course		Flamagement	i acomai

Тур Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias VIcek Lecturer

DE Language

WiSe/SoSe Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Module M0734: Electi	ical Engineering Project Laboratory
Courses	
Title	Typ Hrs/wk CP
Electrical Engineering Project Labo	26
Module Responsible	Prof. Christian Becker
Admission Requirements	None
Recommended Previous	Electrical Engineering I, Electrical Engineering II
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate
	respective relationships. They are capable of describing and communicating relevant problems and questions using approprial
	technical language. They can explain the typical process of solving practical problems and present related results.
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problem
Skins	They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students a
	able to develop, compare, and choose conceptual solutions for non-standardized problems.
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the
	context of electrical engineering. They are able to effectively present and explain their results alone or in groups in front of
	qualified audience. Students have the ability to develop alternative approaches to an electrical engineering proble
	independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gain
Autonomy	in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they ca
	meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112
Credit points	6
Examination	Subject theoretical and practical work
Examination duration and	based on task + presentation
scale	Constant Ferriman Colors (Company of Constant Co
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
rollowing Curricula	Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0640: Electrical Eng	ineering Project Laboratory
Тур	Project-/problem-based Learning
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.
	Alle and Double bound do Decision and a Contract Contract Fresh in her Manuel a Debugli they below the board of
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 Energy and Environmental Engineering

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

The exponential increase in world population, the raised living standards and the continuously increasing hunger for feedstocks, acreage and energy make imperative the sustainable handling of natural resources. This includes the reduction of emissions and the minimisation of environmental impact. An example with growing significance is the control of the CO₂ emissions that are responsible for the greenhouse effect. For this, possibilities are sought that bring energy savings or involve increased use of renewable energy sources. In a continued utilisation of fossil fuels the reduction of CO₂ emissions is pursued by increasing efficiency and also through separation and underground storage of the CO₂ emitted. The latter approaches make a close cooperation between Energy Engineering and Environmental Engineering unavoidable.

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

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

Courses				
Title		Tun	Hrs/wk	СР
Computer Engineering (L0321)		Typ Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge	The successful completion of the labs will be honored drules:	uring the evaluation of the module's e	xamination accor	ding to the follow
	Upon a passed module examination, the student such that the examination's marks are lifted by (The improvement of the grade 5,0 up to 4,3 and	0,3 or 0,4, respectively, up to the next-		the successful la
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the function programming down to gates. The module includes the form		s the layers from	the assembly-le
Chille	Combinational logic: Gates, Boolean algebra, Boolean Sequential logic: Flip-flops, automata, systematic Technological foundations Computer arithmetic: Integer addition, subtractic Basics of computer architecture: Programming m Memories: Memory hierarchies, SRAM, DRAM, ca	on, multiplication and division nodels, MIPS single-cycle architecture, ches J, principles of passing data, point-to-p	pipelining oint connections,	busses
SKIIIS	The students perceive computer systems from the arch composition of computer systems. The students can ar collection of few and simple components. They are ab today's computing systems - from gates and circuits up	alyze, how highly specific and individule to distinguish between and to expl	ial computers car	be built based o
	After successful completion of the module, the studer system and the software executed on it. In particular, on the hardware-centric abstraction layers from the as the impact that these low abstraction levels have on an	they shall understand the consequenc sembly language down to gates. This	es that the execu way, they will be	ition of software l enabled to evalu
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in	a group and to present the results acc	ordingly.	
Autonomy	Students are able to acquire new knowledge from spec	ific literature and to associate this kno	wledge with other	classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
Assignment for the Following Curricula	General Engineering Science (German program): Core (General Engineering Science (German program, 7 seme		e: Compulsory	

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

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

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

	amentals of Materials Science			
Courses				
Fitle Fundamentals of Materials Science	I (L1085)	Typ Lecture	Hrs/wk	CP 2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (Physical and Chemical Basics of Materials Science (L1095)		Lecture Lecture	2 2	2
Module Responsible	Prof. Jörg Weißmüller			
-				
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence	The taking part succession, y stauting have readined the follow	g .cag .csa.cs		
Knowledge	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. The for materials and can identify relevant approaches for chaphenomena back to the underlying physical and chemical laws	ally the issues of atom ne students know abou tracterizing specific pro	ic structure, microstructure the key aspects of chara	re, phase diagram acterization metho
Skills	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stre resistance, and to phase transformations such as solidification between processing conditions and the materials microstructum aterial's behavior.	ngth, ductility, and stif n, precipitation, or me	fness, chemical propertie elting. The students can	es such as corrosio explain the relatio
Personal Competence				
Personal Competence Social Competence	-			
	-			
Social Competence Autonomy	- - Independent Study Time 96, Study Time in Lecture 84			
Social Competence Autonomy				
Social Competence Autonomy Workload in Hours Credit points	6			
Social Competence Autonomy Workload in Hours Credit points	6 Written exam			
Social Competence Autonomy Workload in Hours Credit points Examination	6 Written exam			
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and	6 Written exam	Energy and Enviromer	ntal Engineering: Compuls	sory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale	6 Written exam 180 min			sory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation	Mechanical Engineerin	ng: Compulsory	sory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Mechanical Engineerin Biomedical Engineerin	g: Compulsory g: Compulsory	ory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co	ng: Compulsory g: Compulsory ompulsory	
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica	ng: Compulsory ng: Compulsory ompulsory al Engineering: Compulson	ry
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Biomedica	ng: Compulsory g: Compulsory ompulsory al Engineering: Compulson al Engineering: Compulson	ry
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Biomedica pecialisation Naval Arci	ng: Compulsory g: Compulsory pmpulsory al Engineering: Compulsor al Engineering: Compulsor hitecture: Compulsory	ry ry
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	6 Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Biomedica pecialisation Naval Arci pecialisation Energy an	ng: Compulsory g: Compulsory pmpulsory al Engineering: Compulsor al Engineering: Compulsor hitecture: Compulsory	ry ry
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Biomedica pecialisation Naval Arcl pecialisation Energy an apulsory	ng: Compulsory g: Compulsory pmpulsory al Engineering: Compulsor al Engineering: Compulsor hitecture: Compulsory ad Enviromental Engineeri	ry ry ing: Compulsory
Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S Energy and Environmental Engineering: Core Qualification: Con	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Biomedica pecialisation Naval Arcl pecialisation Energy an apulsory Energy and Enviroment	ng: Compulsory g: Compulsory g: Compulsory al Engineering: Compulsor hitecture: Compulsory ad Enviromental Engineeri	ry ry ing: Compulsory
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Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester):	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanica pecialisation Naval Arch pecialisation Energy an apulsory Energy and Enviroment Mechanical Engineering Naval Architecture: Cor ecialisation Mechanica ecialisation Biomedical ecialisation Naval Arch	ag: Compulsory ag: Compulsory ag: Compulsory al Engineering: Compulsor al Engineering: Compulsor ad Enviromental Engineeri atal Engineering: Compulsor g: Compulsory g: Compulsory mpulsory Il Engineering: Compulsory	ry ry ing: Compulsory ory
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Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester):	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanical pecialisation Naval Arch pecialisation Energy an application Energy and pulsory Energy and Enviroment Mechanical Engineering Naval Architecture: Cor ecialisation Mechanica ecialisation Biomedical ecialisation Naval Arch ecialisation Energy and	ag: Compulsory ag: Compulsory ag: Compulsory al Engineering: Compulsor al Engineering: Compulsor ad Enviromental Engineeri atal Engineering: Compulsor g: Compulsory g: Compulsory mpulsory Il Engineering: Compulsory	ry ry ing: Compulsory ory
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Social Competence Autonomy Workload in Hours Credit points Examination Examination duration and scale Assignment for the	Written exam 180 min General Engineering Science (German program): Specialisation General Engineering Science (German program, 7 semester): S Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): Specialisation General Engineering Science (English program, 7 semester): Specialisation General Engineering Science (English program, 7 semester): Specialisation Science (English program, 7 semester): Specialisation Engineering Science: Election Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory	Mechanical Engineerin Biomedical Engineerin Naval Architecture: Co pecialisation Mechanical pecialisation Naval Arch pecialisation Energy an application Energy and pulsory Energy and Enviroment Mechanical Engineering Naval Architecture: Cor ecialisation Mechanica ecialisation Biomedical ecialisation Naval Arch ecialisation Energy and	ag: Compulsory ag: Compulsory ag: Compulsory al Engineering: Compulsor al Engineering: Compulsor ad Enviromental Engineeri atal Engineering: Compulsor g: Compulsory g: Compulsory mpulsory Il Engineering: Compulsory	ry ry ing: Compulsory ory
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Course L1085: Fundamentals	s of Materials Science I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

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

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

Module M0598: Mech	anical Engineering: Design			
Courses				
Fitle Embodiment Design and 3D-CAD (I	0268)	Typ Lecture	Hrs/wk	CP 1
Mechanical Design Project I (L0695		Project-/problem-based Learning	3	2
Mechanical Design Project II (L0592		Project /problem-based Learning	3	2
eam Project Design Methodology		Project-/problem-based Learning	2	1
Module Responsible Admission Requirements	None			
Recommended Previous	None			
Knowledge	 Fundamentals of Mechanical Engineering Design 	gn		
Miowicage	Mechanics			
	 Fundamentals of Materials Science 			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain design guidelines for machinery parts of the second	e a considering load situation materials an	d manufactur	ing requirements
	 describe basics of 3D CAD, 	e.g. considering load steadton, materials an	a manaractar	mg requirements,
	 explain basics methods of engineering designing 	ng.		
CI:II-	After a section the second of second on the second of the			
SKIIIS	After passing the module, students are able to:			
	 independently create sketches, technical draw 	ings and documentations e.g. using 3D CAL),	
	 design components based on design guidelines 	s autonomously,		
	 dimension (calculate) used components, 			
	use methods to design and solve engineering of the second solve and the second solve engineering of the second solve engi	design tasks systamtically and solution-orie	nted,	
	 apply creativity techniques in teams. 			
Personal Competence				
Social Competence	After passing the module, students are able to:			
	develop and evaluate solutions in groups include	ding making and documenting decisions		
	 moderate the use of scientific methods, 	and making and accumenting accisions,		
	 present and discuss solutions and technical dra 	awings within groups,		
	 reflect the own results in the work groups of th 	e course.		
Δutanamy	Students are able			
, ideanomy				
	to estimate their level of knowledge using act		ith clickers),	
	 To solve engineering design tasks systematica 	lly.		
Workload in Hours	Independent Study Time 40, Study Time in Lecture 14	40		
Credit points	6			
Examination				
Examination duration and	180			
scale				
Assignment for the	General Engineering Science (German program): Spe-	cialisation Energy and Enviromental Engine	ering: Compu	Isory
Following Curricula	General Engineering Science (German program): Spe			
	General Engineering Science (German program): Spe-	cialisation Biomedical Engineering: Compul	sory	
	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical Enginee	ring: Compuls	ory
	General Engineering Science (German program, 7 ser			-
	General Engineering Science (German program, 7 ser		ental Enginee	ring: Compulsory
	Energy and Environmental Engineering: Core Qualific		ring. Comm.	sory
	General Engineering Science (English program): Spec General Engineering Science (English program): Spec			SUI Y
	General Engineering Science (English program): Spec	, , , , , , , , , , , , , , , , , , ,	,	
	General Engineering Science (English program). Spec	- ·	•	ory
	General Engineering Science (English program, 7 sem	- · ·		-
	General Engineering Science (English program, 7 sem	nester): Specialisation Energy and Envirome	ental Engineer	ing: Compulsory
	Mechanical Engineering: Core Qualification: Compulso	pry		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			

Course L0268: Embodiment Design and 3D-CAD		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings	
Literature	 CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. 	

Course L0695: Mechanical Design Project I		
Тур	Project-/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 Design Project II		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	SoSe	
Content	 Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing) 	
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.	

Course L0267: Team Project	Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides 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 M0536: Funda	mentals of Fluid Mechanics				
Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Fluid Mechanics (Li		Lecture	2	4	
Fluid Mechanics for Process Enginee		Recitation Section (large)	2	2	
Module Responsible					
Admission Requirements	None				
Recommended Previous	Mathematics I+II+III				
Knowledge	Technical Mechanics I+II				
	 Technical Thermodynamics I+II 				
	Working with force balances				
	Simplification and solving of partial different Integration	tial equations			
	 Integration 				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results			
Professional Competence					
Knowledge	Students are able to:				
	explain the difference between different type	pes of flow			
	 give an overview for different applications of 		ss engineering		
	explain simplifications of the Continuity- and	d Navier-Stokes-Equation by using physical	boundary condit	ions	
Skille	The students are able to				
Skilis	The students are able to				
	 describe and model incompressible flows m 	•			
	reduce the governing equations of fluid med		ative solutions e	.g. by integration	
	notice the dependency between theory and use the learned basis for fluid dynamical a				
	 use the learned basics for fluid dynamical a 	pplications in fleids of process engineering			
Personal Competence					
Social Competence	The students				
	are capable to gather information from sub	ject related, professional publications and	relate that inforn	nation to the contex	
	of the lecture and				
	 able to work together on subject related to 	sks in small groups. They are able to pres	ent their results	effectively in Englis	
	(e.g. during small group exercises)				
	 are able to work out solutions for exercises 	by themselves, to discuss the solutions ora	lly and to presen	t the results.	
Autonomy	The students are able to				
	- course further literature for each tonic and	to account their league of the third literature			
	 search further literature for each topic and t work on their exercises by their own and to 				
	work on their exercises by their own and to	evaluate their actual knowledge with the K	ecuback.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56			
Credit points					
Examination					
Examination duration and	3 hours				
scale					
-	General Engineering Science (German program): S		-		
_	General Engineering Science (German program): S		-		
	General Engineering Science (German program): S			lsory	
	General Engineering Science (German program, 7 General Engineering Science (German program, 7		, ,	nrv	
				-	
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory				
	Energy and Environmental Engineering: Core Qualification: Compulsory				
	ulsory				
General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory					
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory				
			_		
	General Engineering Science (English program, 7 s				
	General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s	semester): Specialisation Bioprocess Engine	ering: Compulso	-	
	General Engineering Science (English program, 7 s	semester): Specialisation Bioprocess Engine semester): Specialisation Energy and Enviro	ering: Compulso	-	

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows
Literature	compressible flows 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 6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
	 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
	11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. 12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

se L0092: Fluid Mechan	cs for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. 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: 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 10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. 12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Module M0610: Electi	rical Machines			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular complexe number	s, integrals, differentials		
Knowledge	Basics of electrical engineering and mechanical engine	eering		
Educational Objectives	After taking part successfully, students have reached t	he 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 standard to	mos of electric machines and proce	ant the correspond	ding equations and
	They can describe the function of the standard ty characteristic curves. For typically used drives they ca			
	from the power grid to the driven engine.	explain the major parameters of the	energy emelericy	or the miore system
Skills	Students arw able to calculate two-dimensional electr		rromagnetic circ	uits with air gap. For
	this they apply the usual methods of the design auf ele	ectric machines.		
	They can calulate the operational performance of ele	ctric machines from their given chara	cteristic data and	d selected quantities
	and characteristic curves. They apply the usual equiva	lent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate electric a	and magnatic fields for applications. The	ney are able to ar	nalyse independently
	the operational performance of electric machines from	n the charactersitic data and theycar	calculate thereo	f selected quantities
	and characteristic curves.			
	Independent Study Time 110, Study Time in Lecture 70)		
Credit points				
Examination				
Examination duration and	120 Minuten			
scale	Consul Engineering Science (Corner program), Cossi	aliantian Engrava and Engiremental Eng	in a anima. Camanu	laam.
Assignment for the Following Curricula	General Engineering Science (German program): Speci General Engineering Science (German program): Speci			isui y
Following Curricula	General Engineering Science (German program): Speci General Engineering Science (German program, 7 sem			ring: Compulsory
	General Engineering Science (German program, 7 sem			
	Electrical Engineering: Core Qualification: Elective Com		.ccg. Licetive	2011.pa.201 y
	Energy and Environmental Engineering: Core Qualificat			
	General Engineering Science (English program): Specia		neering: Compuls	sory
	General Engineering Science (English program): Specia			
	General Engineering Science (English program, 7 seme	ester): Specialisation Energy and Enviro	omental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engin	eering: Elective C	ompulsory
	Computational Science and Engineering: Specialisation	Engineering Sciences: Elective Comp	ulsory	
	Logistics and Mobility: Specialisation Engineering Scier	nce: Elective Compulsory		
	Mechanical Engineering: Core Qualification: Elective Co	ompulsory		
	Mechatronics: Core Qualification: Compulsory			

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

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

Module M0618: Renev	vables and Energy Systems			
Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Industr	y (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
•	Prof. Martin Kaltschmitt			
•	None			
	none			
Knowledge				
_	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
	With completion of this module, the students can pro			
	efficiency. They can explain the issues occurring in this			
	distribution and power trading wih regard to subje			-
	applicable to many energy systems in general, espec the students can explain the environmental benefits fr		a critical discus	s them. Furthermore,
	the students can explain the environmental benefits if	off the use of such systems.		
Skills	Students are able to apply methodologies for detailed	determination of energy demand or e	nergy production	n for various types of
	energy systems. Furthermore, they can evaluate ener			
	under certain given conditions. Therefore, they ca	n choose the necessary subject-spe	cific calculation	rules, also for not
	standardized solutions of a problem.			
	The students are able to explain questions and possible approaches to its processing from the field of renewable energies orally			
	and to put them them into the right context.			
Personal Competence				
	The students are able to analyze suitable technical			-
	criteria under sustainability aspects. This allows them	to make an enective contribution to a i	nore sustainable	e power suppry.
Autonomy	Students can independently exploit sources , acquire	e the particular knowledge about the s	subject area and	transform it to new
	questions.			
Markland in House	Independent Study Time OF Study Time in Leature OA			
	Independent Study Time 96, Study Time in Lecture 84 6			
Credit points Examination				
Examination duration and				
scale	5 Hours William Exam			
	General Engineering Science (German program): Speci	alisation Energy and Environmental Eng	ineering: Compu	Isory
_	General Engineering Science (German program, 7 sem			-
_	General Engineering Science (German program, 7 s			
	Elective Compulsory		Jg, 100	
	Energy and Environmental Engineering: Core Qualifica	tion: Compulsory		
	General Engineering Science (English program): Specia		neering: Compul	sory
	General Engineering Science (English program, 7 seme			-
	General Engineering Science (English program, 7 s			
	Elective Compulsory	•	J	5, -,

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 Cost and efficiency calculation
Literature	Folien der Vorlesung

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

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

Course L1434: Renewable Energy				
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	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 			

Module M0956: Measu	urement Technology for Mechanical a	nd Process Engineers			
Courses					
Title		Тур	Hrs/wk	СР	
Practical Course: Measurement and	Control Systems (L1119)	Practical Course	2	2	
Measurement Technology for Mecha	anical and Process Engineers (L1116)	Lecture	2	3	
Measurement Technology for Mecha	anical and Process Engineers (L1118)	Recitation Section (large)	1	1	
Module Responsible	NN				
Admission Requirements	None				
Recommended Previous	Basic knowledge of physics, chemistry and electrical en	gineering			
Knowledge					
Educational Objectives	After taking part successfully, students have reached th	e following learning results			
Professional Competence					
Knowledge	Students are able to name the most important fundme	entals of the Measurement Technol	ogy (Quantities and	Units, Uncertainty,	
	Calibration, Static and Dynamic Properties of Sensors a	nd Systems).			
	They can outling the most important measuring method	ade for different kinds of quantities	to be massured (Floatrical Quantities	
	They can outline the most important measuring methor Temperature, mechanical quantities, Flow, Time, Frequ	·	to be maesureu (i	riectrical Quantities,	
	remperature, mechanical quantities, frow, filme, frequ	ency).			
	They can describe important methods of chemical Analy	rsis (Gas Sensors, Spectroscopy, Ga	s Chromatography)		
Skills	Students can select suitable measuring methods to give	n problems and can use refering m	easurement devices	in practice.	
	The students are able to erally explain issues in the su	high area of measurement technol	oay and colution an	proachos as well as	
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.				
	place the issues into the right context and application a	. Cu.			
Personal Competence					
Social Competence	Students can arrive at work results in groups and docum	nent them in a common report.			
Autonomy	Students are able to familiarize themselves with new me	easurement technologies.			
Workload in Hours	Indonesia dest Chiele Tiese 110 Chiele Tiese in Leature 70				
	Independent Study Time 110, Study Time in Lecture 70				
Examination	6 Written evam				
	105 minutes				
scale	103 minutes				
	General Engineering Science (German program, 7 seme	ster): Specialisation Energy and En	viromental Engineer	ing: Compulsory	
_	General Engineering Science (German program, 7 seme				
i onoming carricula					
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 semes		romental Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 semes		-		
	General Engineering Science (English program, 7 semes				
	Mechanical Engineering: Core Qualification: Compulsory		3 32	•	
	Mechatronics: Core Qualification: Compulsory				
	Process Engineering: Core Qualification: Compulsory				
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Course L1119: Practical Cour	rse: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseous
	pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will
	be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with
	Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
Literature	Version 1.
	• Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl.,
	Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974
	Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Vorlag München Wien 1979
	 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 Dekin L. Gushaw R.: Optisch Fibra Spacers Principles and Companyable Artech Hause Reston 1988.
	 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
	Cushaw, C., Bakin, J.: Optical Fibre Scrisors. Systems and Application. Aftect Floads Boston, 1905
	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 and Process Engineers
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Roland Harig
Language	DE
Cycle	
Content	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front of the class.
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

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

Module M1275: Enviro	onmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Te	echnology (L1387)	Practical Course	1	1
Environmental Technologie (L0326)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biolo	ogy		
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain	profound knowledge of environme	ntal technology. They	are able to describe
	the behaviour of chemicals in the environment. Stude	ents can give an overview of scient	tific disciplines involve	ed. They can explain
	terms and allocate them to related methods.			
Skille	Students are able to propose appropriate manageme	ant and mitigation measures for a	nuironmontal problem	as Thou are able to
SKIIIS	determine geochemical parameters and to assess the		·	-
	work out well founded opinions on how Environmenta			
	and defend these opinons in front of and against the g		nable development, d	and they can present
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able		olinary. They are able	
	to develop different approaches to the task as a group	as well as to discuss their theoret	ical or practical impler	mentation.
Autonomy	Students can independently exploit sources about of the	he subject, acquire the particular k	nowledge and tranfer	it to new problems.
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Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and	1 hour			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Energy and E	Enviromental Engineer	ring: Compulsory
Following Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engi	neering: Elective Com	pulsory
	General Engineering Science (German program, 7 sem	ester): Specialisation Bioprocess E	ngineering: Elective C	Compulsory
	Bioprocess Engineering: Core Qualification: Elective Co	ompulsory		
	Energy and Environmental Engineering: Core Qualifica	tion: Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Energy and E	nviromental Engineeri	ing: Compulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engir	eering: Elective Comp	oulsory
	General Engineering Science (English program, 7 seme		igineering: Elective Co	ompulsory
	Process Engineering: Core Qualification: Elective Comp	pulsory		

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

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

Module M0538: Heat	and Mass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	 The students are capable of explaining qualitative a 	nd determining quantitative heat	transfer in proced	lural annaratus (e. n
	heat exchanger, chemical reactors).	nd determining quantitative near	transier in proced	iurar apparatus (e. g.
	They are capable of distinguish and characterize differences.	ferent kinds of heat transfer mec	hanisms namely h	eat conduction, heat
	transfer and thermal radiation.		,	,
	The students have the ability to explain the phy	sical basis for mass transfer in	detail and to de	scribe mass transfer
	qualitative and quantitative by using suitable mass	ransfer theories.		
	They are able to depict the analogy between heat- a	nd mass transfer and to describe	complex linked pr	ocesses in detail.
Skills				
Skills	 The students are able to set reasonable system bo 	undaries for a given transport pr	oblem by using th	ne gained knowledge
	and to balance the corresponding energy and mass	flow, respectively.		
	 They are capable to solve specific heat transfer pro 	oblems (e.g. heated chemical rea	ctors, temperatur	e alteration in fluids)
	and to calculate the corresponding heat flows.			
	Using dimensionless quantities, the students can ex			
	They are able to distinguish between diffusion, conv			n use this knowledge
	for the description and design of apparatus (e.g. ext			
	In this context, the students are capable to choose a	-	heat and mass exc	changer for a specific
	application considering their advantages and disadv		rocodural apparat	116
	 In addition, they can calculate both, steady-state an The students are capable to connect their know 			
	particular the courses thermodynamics, fluid med			
	problems.	iames and enemical process on	gccg, to solv	c concrete teenmean
	·			
Personal Competence				
Social Competence				
	The students are capable to work on subject-specification.	ic challenges in teams and to pre	esent the results o	rally in a reasonable
	manner to tutors and other students.			
Autonomy				
	The students are able to find and evaluate necessar	,		
	They are able to prove their level of knowledge of the second secon	-		continuously (clicker-
	system, exam-like assignments) and on this basis th	ey can control their learning proc	esses.	
Mouldeed in Herma	Indonesiant Study Tipes 124 Study Tipes in Leature 56			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination				
	120 minutes; theoretical questions and calculations			
scale	120 minutes, theoretical questions and calculations			
	General Engineering Science (German program, 7 semeste	r): Specialisation Process Enginee	ering: Compulsory	
Following Curricula				orv
. onouning curricula	General Engineering Science (German program, 7 semeste			-
	Bioprocess Engineering: Core Qualification: Compulsory	.,pecialisation Energy and Env		g. 55.11pai501y
	Energy and Environmental Engineering: Core Qualification:	Compulsory		
	General Engineering Science (English program, 7 semester	• •	ring: Compulsorv	
	General Engineering Science (English program, 7 semester			ry
	General Engineering Science (English program, 7 semester			-
	Technomathematics: Specialisation III. Engineering Science		3	
	Process Engineering: Core Qualification: Compulsory			
	•			

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

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

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

Module M0546: Thern	nal Separation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01	.18)	Lecture	2	2
Thermal Separation Processes (L01		Recitation Section (small)	2	2
Thermal Separation Processes (L01	41)	Recitation Section (large)	1	1
Separation Processes (L1159)		Practical Course	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge				
	The students can distinguish and describe differe	nt types of separation processes	such as distillat	tion, extraction, and
	adsorption The students develop an understanding for the sev	urea of concentration during a cons	ration process t	he estimation of the
	The students develop an understanding for the country demand of a process, the possibilities of one operated demand of a process.			ne estimation of the
	 energy demand of a process, the possibilities of ene They have good knowledge of designing methods for 			
	They have good knowledge of designing methods to	i separation processes and devices		
Skills	Using the gained knowledge the students can select	t a reasonable system houndary fo	r a given senara	tion process and can
	close the associated energy and material balances	t a reasonable system boundary to	i a given separa	tion process and can
	The students can use different graphical methods	for the designing of a separation	n process and d	efine the amount of
	theoretical stages required	to the designing of a separation	. process and a	emie ene amount or
	They can select and design a basic type of therm	nal separation process for a given	case based on	the advantages and
	disadvantages of the process			J
	The students are capable to obtain independently t	he needed material properties from	n appropriate so	urces (diagrams and
	tables)			
	They can calculate continuous and discontinuous pr	ocesses		
	The students are able to prove their theoretical known	wledge in the experimental lab worl	k.	
	The students are able to discuss the theoretical back	kground and the content of the ex	perimental work	with the teachers in
	colloquium.			
	The students are capable of linking their gained knowledge	with the content of other lectures	and use it togeth	ner for the solution of
	technical problems. Other lectures such as thermodynamic			
Personal Competence				
Social Competence				
	The students can work technical assignments in small	all groups and present the combine	d results in the to	utorial
	The skindaghes are able to account our skind lab our	ale in annual annual and annual annual	£ k! 1 - 1! - ! - !	
	 The students are able to carry out practical lab we them. They are able to discuss their results and to d 			on of labor between
	them. They are able to discuss their results and to d	ocument them scientifically in a rep	JOIL.	
Autonomy				
	The students are capable to obtain the needed infor	·		
	The students can proof the state of their knowled	age with exam resembling assign	ments and in th	is way control their
	learning process			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 94			
Credit points	Independent Study Time 96, Study Time in Lecture 84			
-	Written exam			
examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the	General Engineering Science (German program, 7 semeste	er): Specialisation Process Engineeri	na: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semesters) General Engineering Science (German program, 7 semesters)			nrv
i onowing curricula	General Engineering Science (German program, 7 semesters) General Engineering Science (German program, 7 semesters)	· ·		-
	Bioprocess Engineering: Core Qualification: Compulsory	a, a specialisation Elicity and Eliviit	mentai Engineel	ing. Compulsory
	Energy and Environmental Engineering: Core Qualification:	Compulsory		
	General Engineering Science (English program, 7 semester		ig: Compulsorv	
	General Engineering Science (English program, 7 semester	· ·		~
	General Engineering Science (English program, 7 semester			-
	Process Engineering: Core Qualification: Compulsory	. ,		J
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Course L0118: Thermal Sepa	ration Processes
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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

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

Course L1159: Separation Processes			
Тур	Practical Course		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.		
Lecturer	Prof. Irina Smirnova		
Language			
01-	wee.		
Cycle			
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiunt 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. The receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they call increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes		
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 		

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP
Introduction to Control Systems (L0 Introduction to Control Systems (L0	
Module Responsible	
Admission Requirements	
-	Representation of signals and systems in time and frequency domain, Laplace transform
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	a. Students can represent dynamic system helpavier in time and frequency demain, and can in particular explain preparties
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties first and second order systems
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response a
	root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	
	Students can transform models of linear dynamic systems from time to frequency domain and vice versa They are simplest and appear the behavior of systems and appear to the second systems.
	 They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules
	They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
	They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digitations.
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Parsanal Compotance	
Personal Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use
riaconomy	when solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	
Credit points	
Credit points	6 Written exam
Credit points Examination	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: 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 Theoretical Mechanic Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Sciences (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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft System Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Sciences (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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Systet Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systet Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme and Production: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic 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 Energy Systen Compulsory Bioprocess Engineering Science (German program, 7 semester): Specialisation Mechanical Enginee
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Forcess Engineering: 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 Biomechanic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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 Theoretical Mechanic Engineering: Compulsory General Engineering Science (German program, 7 semester): Speciali
Credit points Examination 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 Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic 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 Aircraft Syster Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syster Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic 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 Energy Systen Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	to 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 D. C. Burfand B. H. Bishan, "Modern Control Systems", Addison Works, Boother, MA 2010.
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0639: Gas a	nd Steam Power 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	Prof. Alfons Kather			
Admission Requirements	None			
Recommended Previous				
Knowledge	 "Technical Thermodynamics I and II" 			
	"Heat Transfer" ""			
	"Fluid Mechanics"			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,	3 3		
•	The students can evaluate the development of the elec	tricity demand and the energy con	version routes in	the thermal power
	plant, describe the various types of power plant and the			· ·
	operation characteristics of the power plant. Addition			
	combination possibilities of conventional fossil-fuelled p			
	equipped with Carbon Capture and Storage.			
	The students have basic knowledge about the principles,	operation and design of turbomachi	nery	
61.77	The students will be able using blacking and an in-	of the energy technology for	soil fuels and I	cod on well formal
Skills	The students will be able, using theories and methods			
	knowledge on the function and construction of gas and st and electricity, so as to develop conceptual solutions.			-
	between heat and power generation the students are en			
	concepts for the generation of electricity and the produc			
	follow better the deliberations on the electricity mix com			-
	environmental protection).	position within the energy pointed to	indrigic (economi	y, secure supply und
	environmental protection//			
	Within the framework of the exercise the students learn t	he use of the specialised software su	uite EBSILON Prof	essional TM . With this
	tool small practical tasks are solved with the PC, to highli	ght aspects of the design and develo	pment of power	plant cycles.
	The students are able to do simplified calculations on tu	urhomachinory oithor as part of a pl	ant as single se	mnonont or at stage
	level.	irboniacilinery either as part of a pr	ant, as single co	imponent or at stage
	ievei.			
Personal Competence				
Social Competence	An excursion within the framework of the lecture is plann	ed for students that are interested. 1	The students get	in this manner direct
	contact with a modern power plant in this region. The s	tudents will obtain first-hand experi	ence with a pow	er plant in operation
	and gain insights into the conflicts between technical and	political issues.		
Autonomy	The students assisted by the tutors will be able to develo	p alone simple simulation models an	d run with these	scenario analyses. In
	this manner the theoretical and practical knowledge fr	om the lecture is consolidated and	the potential e	ffects from different
	process combinations and boundary conditions highlig	hted. The students are able indep	endently to ana	lyse the operational
	performance of steam power plants and calculate selecte	d quantities and characteristic curve	es.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination				
	Written examination of 120 min			
scale	The continue of the continue o			
	General Engineering Science (German program, 7 semest	er): Specialisation Energy and Enviro	omental Enginee	ring: Compulsorv
Following Curricula			,	, ,
, , ,	Elective Compulsory	. ,	3, 100	5, -,
	General Engineering Science (German program, 7 semesi	er): Specialisation Energy and Enviro	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 sen		_	
	Elective Compulsory		<u> </u>	,
	Energy and Environmental Engineering: Core Qualification	n: Compulsory		
	Energy and Environmental Engineering: Core Qualification			
	Energy Systems: Technical Complementary Course Core	Studies: Elective Compulsory		
	General Engineering Science (English program, 7 semeste	er): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical E	Engineering, Foc	us Energy Systems:
	Elective Compulsory			
	General Engineering Science (English program, 7 semeste	er): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical E	Engineering, Foc	us Energy Systems:
	Elective Compulsory			
	Mechanical Engineering: Specialisation Energy Systems: I			
	Mechanical Engineering: Specialisation Energy Systems: I	Elective Compulsory		

Course L0206: Gas and Steam	n Power Plants
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
	Electricity demand and Forecasting Thermodynamic fundamentals Energy Conversion in thermal power plants Layout of the power plant Layout of the power plant Layout 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

Course L0210: Gas and Steam	m Power Plants
Тур	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	
Language	
Cycle	
Content	
Content	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus of
	the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and
	renewable energy sources are discussed and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM. With thi tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterwards ask questions and get feedback. The course work has a positive effect on the students final grade.
Literature	 Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T . Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Module M0670: Partic	cle Technology and Solids Process Eng	jineering		
Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L0434)		Lecture	2	3
Particle Technology I (L0435)		Recitation Section (small)	1	1
Particle Technology I (L0440)		Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	After successful completion of the module students are	able to		
	 name and explain processes and unit-operation: 	s of solids process engineering,		
	characterize particles, particle distributions and	to discuss their bulk properties		
Skills	Students are able to			
	choose and design apparatuses and processes for the second s	, ,	esired solids prop	perties of the product
	asses solids with respect to their behavior in soli	ds processing steps		
	 document their work scientifically. 			
Personal Competence				
Social Competence	The students are able to discuss scientific topics ora	lly with other students or scientific p	ersonal and to	develop solutions for
	technical-scientific issues in a group.			
Autonomy	Students are able to analyze and solve questions regar	ding solid particles independently.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	<u> </u>		
Credit points	6	<u> </u>		
•				
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 sem			ory
•	General Engineering Science (German program, 7 sem			•
	Bioprocess Engineering: Core Qualification: Compulsory	· ·	-	
	Energy and Environmental Engineering: Core Qualificat	ion: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 seme	ster): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	Process Engineering: Core Qualification: Compulsory			

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

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

Module M1274: Enviro	onmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
-	Prof. Martin Kaltschmitt			
	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biolog	зу		
Knowledge	After taling north arrange fully attribute hours woodhood the	a fallousing leavaing yearste		
Professional Competence	After taking part successfully, students have reached th	le following learning results		
Knowledge	With the completion of this module the students ac environmental problems which might occur from product about the methodological diversity and are competent impacts. Besides the students are able to estimate the difficulties with their measurement. The students are able to select a suitable method for the can develop suitable solutions for managing and mitigate out Life Cycle Impact Assessments independently and After finishing the course the students have the content of the course of the	in dealing with different methods and complexity of these environmental puth erespective case from the variety of atting environmental problems in a bust can apply the software programs Options.	tion measures. T instruments to a rocesses as well of assessment me siness context. Ti penLCA and the	hey have knowledge ssess environmental as uncertainties and ethods. Thereby they hey are able to carry database Ecolnvent.
Personal Competence Social Competence	environmental impacts. The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity and consciousness towards these subjects are raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business context and are able to judge results of other publications.			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points				
Examination				
Examination duration and	1 hour written exam			
scale				
Assignment for the	General Engineering Science (German program, 7 seme			
Following Curricula				
	General Engineering Science (German program, 7 seme		ing: Elective Com	pulsory
	Bioprocess Engineering: Core Qualification: Elective Cor Bioprocess Engineering: Core Qualification: Elective Cor			
	Energy and Environmental Engineering: Core Qualificati			
	General Engineering Science (English program, 7 semes	' '	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semes	ster): Specialisation Bioprocess Engine	ering: Elective Co	ompulsory
	General Engineering Science (English program, 7 semes		ng: Elective Com	oulsory
	Process Engineering: Core Qualification: Elective Compu	•		
	Process Engineering: Core Qualification: Elective Compu	ilsory		

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

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

Module M0891: Inform	natics for Process Engineers			
Courses				
Title		Тур	Hrs/wk	СР
Informatics for Process Engineers (I		Lecture	2	2
Informatics for Process Engineers (I	L0837)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)	5 M V I	Practical Course	2	2
Module Responsible	Dr. Marcus Venzke None			
Admission Requirements Recommended Previous				
Kecommended Previous Knowledge	Basic knowledge in using MS Windows.			
•	After taking part successfully students have reached the f	allowing learning results		
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence	Chudante san dagaith an acadural and abiast arianted san	a anta		
Knowledge	Students can describe procedural and object-oriented cond	.epis.		
Skills	Students are capable of object-oriented programming in	the programing language Java ar	nd of solving math	ematic questions by
	using Matlab.			
	Students are capable of developing concepts (simple algor	ithms) to solve technical question	S.	
Personal Competence				
Social Competence	Students are able to work out solutions together in small g	roups.		
Autonomy	Students are able to assess acquired skills by applying it in	practice.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Energy an	d Enviromental E	ingineering: Elective
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semeste	er): Specialisation Process Enginee	ring: Elective Com	pulsory
	Bioprocess Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification			
	General Engineering Science (English program, 7 sem	ester): Specialisation Energy an	d Enviromental E	ingineering: Elective
	Compulsory			
	General Engineering Science (English program, 7 semester	r): Specialisation Process Engineer	ing: Elective Comp	oulsory
	Process Engineering: Core Qualification: Compulsory			

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

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

Course L0125: Numeric and	Matlab
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Module M0539: Proce	ss and Plant Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Process and Plant Engineering I (L0095)		Lecture	2	2
Process and Plant Engineering I (L0096)		Recitation Section (large)	1	2
Process and Plant Engineering I (L1)	Recitation Section (small) 1 2			
Module Responsible	Prof. Georg Fieg			
Admission Requirements	None			
Recommended Previous	unit operation of thermal an dmechanical separation process	ses		
Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical	processes		
	specify linear component equations of complex chemical pro	ocesses		
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	 formulation of mass and energy balance equations and estimation of product streams estimation of component streams of chemical plants using linear component balance models solution of data reconcilliation tasks conduction of process synthesis 			
	- economic evaluation of processes and the estimation of pro	oduction costs		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the	General Engineering Science (German program, 7 semester)	· Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester)			nrv
	General Engineering Science (German program, 7 semester)			-
	Compulsory	5, 1		J 11 J 11
	Bioprocess Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering	ng: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engine	ering: Compulsor	ry
	General Engineering Science (English program, 7 semes Compulsory	ter): Specialisation Energy and	Enviromental E	ingineering: Elective
	Process Engineering: Core Qualification: Compulsory			
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Z	Ladama
	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	1. Introduction
	Structure and operation of production plants
	Operational business process
	Technical process design
	Motivation and targets of process development
	Life cycle of production plants
	2. Engineering methods and tools
	Mass and energy balances
	Strategies of process synthesis
	Graphical representation of processes
	Multidimensional regression
	Data reconciliation and data validation

	3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation
Literature	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
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	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
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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	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
Į.	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
1	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
9	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
l l	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
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	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
I	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

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

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

	Tun		
	Typ		
	Тур	Hrs/wk	СР
0)	Recitation Section (large) Lecture	2 3	3
			-
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j			
After taking part successfully, students have reach	ned the following learning results		
 explain the differences between Economics and Management and the sub-disciplines in Management and to na important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprined projects describe and explain basic business functions as production, procurement and sourcing, supply chain management organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. 			
-		jectives, strategi	ies etc.) and to ca
 analyse organisational and staff structures of apply methods for decision making under methods analyse production and procurement systemethods analyse and apply basic methods of market select and apply basic methods from mathe 	of companies nultiple objectives, under uncertainty and ur ns and Business information systems ing matical finance to predefined problems	ıder risk	
 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project. 			
Independent Study Time 110 Study Time in Lectu	re 70		
· · · · · · · · · · · · · · · · · · ·	· ····		
several written exams during the semester			
General Engineering Science (German program, 7	semester): Specialisation Electrical Enginee	ring: Compulson	/
General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory	semester): Specialisation Biomedical Engin- semester): Specialisation Naval Architectur- semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Enviro 1, 7 semester): Specialisation Mechanical 1, 7 semester): Specialisation Mechanical 2 semester): Specialisation Mechanical	eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory	ring: Compulsory Focus Mechatroni Focus Biomechani us Aircraft Syste
	After taking this module, students know the impor and Organisation to Marketing and Innovation, and explain the differences between Econom important definitions from the field of Mana explain the most important aspects of and projects describe and explain basic business functorganization and human ressource managed explain the relevance of planning and do uncertainty, and explain some basic method state basics from accounting and costing and students are able to analyse business units with rout an Entrepreneurship project in a team. In particular, analyse Management goals and structure the analyse organisational and staff structures of apply methods for decision making under meanalyse and apply basic methods of markethese analyse and apply basic methods from mathedelecture to analyse and apply basic methods from mathedelecture to apply their knowledge from the lecture to to communicate appropriately andelecture to to compete respectfully with their fellow states are able to work in a team and to organize the team the to write a report on their project. Independent Study Time 110, Study Time in Lecture Scholar are able to work in a team and to organize the team the to write a report on their project. Independent Study Time 110, Study Time in Lecture Scholar are apply to the semester General Engineering Science (German program, 7 General Engineering Science (German program	Prof. Christoph Ihi None Basic Knowledge of Mathematics and Business After taking part successfully, students have reached the following learning results After taking this module, students know the important basics of many different areas in Busin and Organisation to Marketing and Innovation, and also to Investment and Controlling. In part • explain the differences between Economics and Management and the sub-discipl important definitions from the field of Management • explain the most important aspects of and goals in Management and name the most projects • describe and explain basic business functions as production, procurement and so organization and human ressource management, information management, innovation • explain the relevance of planning and decision making in Business, esp. in situal uncertainty, and explain some basic methods from mathematical Finance • state basics from accounting and costing and selected controlling methods. Students are able to analyse business units with respect to different criteria (organization, ob out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and un enalyse production and procurement systems and Business information systems • analyse and apply basic methods from mathematical finance to predefined problems • analyse and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems • to apply their knowledge from the lecture to an entrepreneurship project and write a controlling to predefined problems • to communicate appropriately and • to communicate appropriatel	Prof. Christoph IIN None Basic Knowledge of Mathematics and Business After taking part successfully, students have reached the following learning results After taking this module, students know the important basics of many different areas in Business and Manage and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are al explain the differences between Economics and Management and the sub-disciplines in Manage important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important asper projects describe and explain basic business functions as production, procurement and sourcing, supply organization and human ressource management, information management, innovation management are explain the relevance of planning and decision making in Business, esp. in situations under mul uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. Students are able to analyse business units with respect to different criteria (organization, objectives, strateg out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse and apply basic methods from mathematical finance to predefined problems analyses and apply basic methods from mathematical finance to predefined problems apply besic methods from accounting, costing and controlling to predefined problems be communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the communicate appropriately and to cooperate respectfully with their fellow stu

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory
Computer Science: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP 3

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Lecturer Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek

Language DE

Cycle WiSe/SoSe

Content In

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 set selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

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.

Module M0561: Discre	ete Algebraic Structures			
Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures (L016	54)	Lecture	2	3
Discrete Algebraic Structures (L016	55)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Mathematics from High School.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebr	aic structures including elementa	ry combinatorial	structures, monoids,
	groups, rings, fields, finite fields, and vector spaces. They a	Iso know specific structures like su	ıb sum-, and qu	otient structures and
	homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete al	lgebraic structures.		
Personal Competence				
-	Students are able to solve specific problems alone or in a g	roup and to present the results acc	cordingly	
Social competence	Students are able to solve specific problems alone or in a group and to present the results accordingly.			
Autonomy	Students are able to acquire new knowledge from specif	ic standard books and to associa	ate the acquired	knowledge to other
	classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisa	tion Computer Science: Compulsor	ry	
Following Curricula	General Engineering Science (German program, 7 semester	r): Specialisation Computer Science	e: Compulsory	
	Computer Science: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisat	ion Computer Science: Compulsory	у	
	General Engineering Science (English program, 7 semester)	: Specialisation Computer Science	: Compulsory	
	Computational Science and Engineering: Core Qualification:	•		
	Computational Science and Engineering: Core Qualification:	: Compulsory		
	Technomathematics: Specialisation I. Mathematics: Elective	e Compulsory		

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

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

Module M0730: Comp	uter Engineering
Courses	
Title	Typ Hrs/wk CP
Computer Engineering (L0321)	Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	
Admission Requirements Recommended Previous	
Knowledge	basic knowledge in electrical engineering
	The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules:
	 Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs such that the examination's marks are lifted by 0,3 or 0,4, respectively, up to the next-better grade. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-lever programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches
Skills	• Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a 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 students are able to judge the interdependencies between a physical compute system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence	
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
	90 minutes, contents of course and labs
scale	General Engineering Science (German program): Core Qualification: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen
	and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program): Core Qualification: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

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

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

Module M0553: Object	toriented Programming, Algorithm	s and Data Structures		
Courses				
Title Objectoriented Programming, Algor	rithms and Data Structures (L0131) rithms and Data Structures (L0132)	Typ Lecture Recitation Section (small)	Hrs/wk 4 1	CP 4 2
	Prof. Rolf-Rainer Grigat	Nectation Section (smail)	1	2
•	-			
Admission Requirements Recommended Previous	None Lecture Prozedurale Programmierung or equivalent	proficioney in imporativo programming		
Knowledge	Lecture Prozedurale Programmerally or equivalent	proficiency in imperative programming		
	Mandatory prerequisite for this lecture is proficient familiar with simple data types (integer, double, countries and you should have used all those in your own debugger. In this lecture we will immediately start above. This remark is especially important for AIW, GES, prerequisites for the start of those curricula in government of the start of those curricula in government.	har), arrays, if-then-else, for, while, proce programs and therefore should be profici with the introduction of objects and we LUM because those prerequisites are n eneral. The programs ET, CI and IIW inc	dure calls or fur ent with editor, will not repeat t ot part of the o	action calls, pointers, compiler, linker and the basics mentioned curriculum. They are
	•			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students can explain the essentials of software d libraries and design patterns.	esign and the design of a class architect	ture with referer	nce to existing class
	Students can describe fundamental data structures sorting and searching.	of discrete mathematics and assess the co	omplexity of imp	ortant algorithms for
Skiils	Students are able to Design software using given design patterns Carry out software development and tests us Sort and search for data efficiently Assess the complexity of algorithms.			
	Students can work in teams and communicate in fo		sitory and Google	le Test independently
Additionly	and over a period of two to three weeks.	as the value compression using 544 repe	sitory and Goog.	e rest independently
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minutes, Content of Lecture, exercises and mate	rial in StudIP		
Assignment for the Following Curricula	General Engineering Science (German program): Sp General Engineering Science (German program, 7 s Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsor General Engineering Science (English program): Sp General Engineering Science (English program, 7 se Computational Science and Engineering: Core Quali Logistics and Mobility: Specialisation Engineering Sc	emester): Specialisation Computer Science ory ecialisation Computer Science: Compulsory emester): Specialisation Computer Science fication: Compulsory	e: Compulsory	
	Technomathematics: Core Qualification: Compulsor	у		

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

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

Module M0672: Signa	ls 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				
Admission Requirements Recommended Previous	None Mathematics 1-3			
Knowledge	Mathematics 1-3			
ioeage	The modul is an introduction to the theory of signals and			
	1-3 is expected. Further experience with spectral transfo	ormations (Fourier series, Fourier tra	nsform, Laplace	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals an	d linear time-invariant (LTI) systems	using methods	of signal and system
	theory. They are able to apply the fundamental transform		_	
	can describe and analyse deterministic signals and syst			
	understand the effects in time domain and image domain discrete-time signal.	ain which are caused by the transi	tion of a continu	ious-time signal to a
Skills	The students are able to describe and analyse determinis	tic signals and linear time-invariant	systems jising r	nethods of signal and
Skins	system theory. They can analyse and design basic sy			
	response, stability, linearity etc They can assess the imp			
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information	from appropriate literature source	es. They can o	control their level of
	knowledge during the lecture period by solving tutorial pr	oblems, software tools, clicker syste	m.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the	General Engineering Science (German program): Specialis	ration Floctrical Engineering: Compu	lcon/	
Following Curricula	General Engineering Science (German program): Specialis			
	General Engineering Science (German program): Specialis			
	General Engineering Science (German program): Specialis			
	General Engineering Science (German program): Specialis	sation Civil- and Enviromental Engen	eering: Compuls	ory
	General Engineering Science (German program): Specialis	sation Mechanical Engineering: Com	oulsory	
	General Engineering Science (German program): Specialis			
	General Engineering Science (German program, 7 semest General Engineering Science (German program, 7 semest			У
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 semest			ory
	General Engineering Science (German program, 7 semest	er): Specialisation Biomedical Engin	eering: Compuls	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanica	Engineering,	Focus Biomechanics:
	Compulsory			
	General Engineering Science (German program, 7 sem	nester): Specialisation Mechanical I	Engineering, Foo	us Energy Systems:
	Compulsory General Engineering Science (German program, 7 sen	postor). Specialisation Mechanical	Enginooring Eo	cus Aircraft Systoms
	Engineering: Compulsory	rester). Specialisation Mechanical	Lingineering, 10	cus Aircraft Systems
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engir	ieering, Focus T	neoretical Mechanical
	Engineering: Compulsory Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialis	ation Civil- and Enviromental Engene	ering: Compuls	ory
	General Engineering Science (English program): Specialis	ation Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialis		-	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semeste			,
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	er): Specialisation Process Engineerin	ng: Compulsory	
	General Engineering Science (English program, 7 semeste	er): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semeste			-
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical	Engineering,	ocus Biomechanics:
	Compulsory General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical F	ngineering For	us Energy Systems
I	Sensial Engineering Science (English program, 7 Sens	ester). Specialisation Mechanical I	g.ii.ceiiiig, 100	.as Energy Systems.

Compulsory	1
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems	
Engineering: Compulsory	l
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	
Sciences: Compulsory	l
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:	
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	
Engineering: Compulsory	
Computational Science and Engineering: Core Qualification: Compulsory	
Computational Science and Engineering: Core Qualification: Compulsory	l
Mechatronics: Core Qualification: Compulsory	l
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	1

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

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

Module M0852: Grapl	n Theory and Optimization			
Courses				
Title Graph Theory and Optimization (L3 Graph Theory and Optimization (L3		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 3 3
Module Responsible		Recitation Section (Smail)	2	3
Admission Requirements				
Recommended Previous	None			
Knowledge	Discrete Algebraic Structures Mathematics I			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	 Students can name the basic concepts in 0 examples. Students can discuss logical connections b the help of examples. They know proof strategies and can reprod 	etween these concepts. They are capable		
Skills	 Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. 			
Personal Competence Social Competence	Students are able to work together in team In doing so, they can communicate new codesign examples to check and deepen the	ncepts according to the needs of their coo		
Autonomy	 Students are capable of checking their und precisely and know where to get help in sol Students have developed sufficient persist problems. 	lving them.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula		semester): Specialisation Computer Sciency specialisation Computer Science: Compulso semester): Specialisation Computer Science alification: Compulsory Science: Elective Compulsory	ce: Compulsory	

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

Course L1047: Graph Theory	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	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0727: Stoch	astics			
Courses				
Title Stochastics (L0777) Stochastics (L0778)		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous				
Knowledge	• Calculus			
	Discrete algebraic structures (combinatorics) Propositional logic			
	• Propositional logic			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Skills Personal Competence Social Competence Autonomy	enough in various application contexts, i.e., students can - Students are able to work together (e.g. on their re different study programs and background knowledge) a - Students are capable of checking their understanding precisely and know where to get help in solving them. - Students can put their knowledge in relation to the con-	ptions) used in discrete and cor- be characteristic notions such as problems and explain algorithms fo- tors as they are caller, can be analy- is of stochastic processes and explai- can also explain basic statistical de- blems, and they can justify wheth- in derive estimators and judge wheth- gular home work) in heterogeneou- ind to present their results appropria- ing of complex concepts on their co- tents of other lectures.	atinuous settings expected values, r solving these pro yzed in terms of no ain algorithms for exection and estima er approximation ther they are applicated solving the composed tear ately (e.g. during expense) www. They can spec	(joint and marginal variance, standard blems (based on the tions such as bias of solving decision and tion techniques. techniques are good able or reliable. The section of the section o
	- Students have developed sufficient persistence to be a	ble to work for longer periods in a g	oal-oriented manne	er on hard problems.
Workload in Hours	, , ,			
Credit points				
Examination	Written exam			
Examination duration and	120 min			
scale	0 15 1 10 10 10			
Assignment for the Following Curricula				
Following Curricula	Computer Science: Core Qualification: Compulsory	ster). Specialisation Computer Scien	ice. Compuisory	
	General Engineering Science (English program): Speciali	sation Computer Science: Compulso	ory	
	General Engineering Science (English program, 7 semes			
	Computational Science and Engineering: Core Qualificat			
	Computational Science and Engineering: Core Qualificat	on: Compulsory		
	Logistics and Mobility: Specialisation Engineering Science	e: Elective Compulsory		

Hrs/wk 2 CP 4 Workload in Hours Independent Study Time 92, Study Time in Lecture 28 Lecturer Dr. Francisco Javier Hoecker-Escuti, Dr. Christian Seifert Language EN Cycle SoSe Content Foundations of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stochastic processes Stochastic processes Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests Stochastic regression	Course L0777: Stochastics	
Workload in Hours Independent Study Time 92, Study Time in Lecture 28	Тур	Lecture
Workload in Hours Lecture Language EN Cycle Sose Content On Perancisco Javier Hoecker-Escuti, Dr. Christian Seifert Language EN Cycle Sose Content On Definitions of probability theory One Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests	Hrs/wk	2
Lecturer Language EN Cycle SoSe Content Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests	СР	4
Language EN Cycle SoSe Content Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests	Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Content Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests	Lecturer	Dr. Francisco Javier Hoecker-Escuti, Dr. Christian Seifert
Content Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests	Language	EN
 Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 	Cycle	SoSe SoSe
 Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 	Content	Foundations of probability theory
 Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		Definitions of probability conditional probability
 Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		
 Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		
Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests		
 Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		Characteristics: expected values, variance, standard deviation, moments
 Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		Practical representations for joint probabilities
 Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		Bayessche Netzwerke
Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests		
 Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		
 Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		Chalianavita, avadiaita
 Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests 		
Detection & estimation • Detectors • Estimation rules and procedures • Hypothesis and distribution tests		
 Detectors Estimation rules and procedures Hypothesis and distribution tests 		- Dynamic Bayesian networks, maden markov networks, kaiman mers, quedes
Estimation rules and proceduresHypothesis and distribution tests		Detection & estimation
Hypothesis and distribution tests		Detectors
		Estimation rules and procedures
Stochastic regression		Hypothesis and distribution tests
		Stochastic regression
Literature	Literature	
Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008	Literature	1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008
2. Stochastik für Informatiker, Dümbgen, L., Springer 2003		
3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010		
4. Stochastik, Georgii, HO., deGruyter, 2009		
5. Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001		
6. Programmieren mit R, Ligges, U., Springer 2008		ь. Programmieren mit R, Ligges, U., Springer 2008

Course L0778: Stochastics	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0624: Autor	nata Theory and Formal Languag	es		
Courses				
Title Automata Theory and Formal Lange		Typ Lecture	Hrs/wk	CP 4
Automata Theory and Formal Lang		Recitation Section (small)	2	2
Module Responsible	• • • • • • • • • • • • • • • • • • • •			
Admission Requirements	Participating students should be able to			
Knowledge	Tarticipating Students Should be able to			
	- specify algorithms for simple data structures (s	uch 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 mo	odule Discrete Algebraic Structures		
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Skills	solving decision problems. Students can show problems are hard to represent with propositio syntax, semantics, and decision problems for the solving the predicate logic SAT decision problem kinds of temporal logic, and identify their apple automata and can identify relationships to log deterministic and nondeterministic finite autor formalism for which nondeterminism is more e problems require which expressivity, and, in add problems w.r.t. other formalisms. They understate for specifying systems and their properties. Students can apply propositional logic as well as problems in order to derive propositional logic, which formalism is best suited for a particular decision problems to specific formulas. Students grammars from automata and vice versa. They emptiness problem in case of infinite words.	anal logic, and therefore, the students can his representation formalism. Students can also describe syntax, semanti lication areas. The participants of the couric and formal grammars. The spectrum the mata and pushdown automata to Turing mata and the some formalisms. They are also lition, students can transform decision problem dents can describe the relationships between predicate logic resolution to a given set of formalisms and they can demonstrated the set of the predication problem, and they can demonstrate and so transform nondeterministic automata.	motivate predicate explain unification content of the content of t	ate logic, and defir on and resolution f problems for variou arious kinds of fini explain ranges fro its can name those trate which decision malism into decision thers are best suited in as logic, automated in They can evaluation of algorithms finistic ones, or derivant
	empliness problem in case of infinite words.			
Personal Competence				
Social Competence				
Autonomy	Independent Charles Time 204 Ct. J. T	56		
	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points Examination				
Examination duration and	90 min			
scale	30 111111			
Assignment for the	General Engineering Science (German program):	Specialization Computer Science: Computer	~V	
Following Curricula	General Engineering Science (German program):	·	-	ulsorv
. ooming curricula	Computer Science: Core Qualification: Compulsor		Licetive comp	a,
	General Engineering Science (English program):		/	
	General Engineering Science (English program, 7		•	lsory
	Computational Science and Engineering: Core Qu			-
	Computational Science and Engineering: Core Qu	• •		
	Technomathematics: Specialisation II. Informatics			

Course L0332: Automata The	eory and Formal Languages
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	
Language	
Cycle	
Content	
-	Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
	Predicate logic, unification, predicate logic resolution
	3. Temporal Logics (LTL, CTL)
	4. Deterministic finite automata, definition and construction
	5. Regular languages, closure properties, word problem, string matching
	6. Nondeterministic automata:
	Rabin-Scott transformation of nondeterministic into deterministic automata
	7. Epsilon automata, minimization of automata,
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
	8. Myhill-Nerode Theorem:
	Correctness of the minimization procedure, equivalence classes of strings induced by automata
	9. Pumping Lemma for regular languages:
	provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive
	enough to solve a word problem for some given language 10. Regular expressions vs. finite automata:
	Equivalence of formalisms, systematic transformation of representations, reductions
	11. Pushdown automata and context-free grammars:
	Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping
	lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and
	back)
	12. Chomsky normal form
	13. CYK algorithm for deciding the word problem for context-free grammrs
	14. Deterministic pushdown automata
	15. Deterministic vs. nondeterministic pushdown automata:
	Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler
	16. Regular grammars
	17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars
	18. Chomsky hierarchy
	19. Mealy- and Moore automata:
	Automata with output (w/o accepting states), infinite state sequences, automata networks
	20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verification
	w.r.t. temporal logic specifications (in particular LTL)
	21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic
	22. Fixed points, propositional mu-calculus
	23. Characterization of regular languages by monadic second-order logic (MSO)
114	
Literature	1. Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.
	2. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006
	3. Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
	4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

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

Module M0803: Embe	dded Systems			
Courses				
Title		Тур	Hrs/wk	СР
Embedded Systems (L0805)		Lecture	3	4
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 th	ne following learning results		
Professional Competence				
Knowledge	Embedded systems can be defined as information proc	essing systems embedded into enclo	sing products. Th	is course teaches the
	foundations of such systems. In particular, it deals with	an introduction into these systems	notions, commo	n characteristics) and
	their specification languages (models of computation,	hierarchical automata, specification	of distributed s	ystems, task graphs
	specification of real-time applications, translations between	reen different models).		
	Another part covers the hardware of embedded systematics	ems: Sonsors, A/D and D/A converte	ers, real-time car	pable communication
	hardware, embedded processors, memories, energy d			
	introduction into real-time operating systems, middle			
	systems using hardware/software co-design (hardware	/software partitioning, high-level tran	sformations of s	pecifications, energy
	efficient realizations, compilers for embedded processo	rs) is covered.		
Ckilla	After having attended the course students shall be a	ble to realize simple embedded syst	ams. The studen	te chall realize which
Skills	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be			
	able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge in			
	which areas of embedded system design specific risks of	·		,
Personal Competence	, , , , ,			
Social Competence	Students are able to solve similar problems alone or in	a group and to present the results acc	ordingly.	
Autonomy	Students are able to acquire new knowledge from speci	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			
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 Science	e: Elective Comp	ulsory
Following Curricula	Computer Science: Specialisation Computer and Softwa	re Engineering: Elective Compulsory		
	Electrical Engineering: Core Qualification: Elective Com	•		
	Aircraft Systems Engineering: Specialisation Avionic and		-	
	General Engineering Science (English program, 7 semes		e: Elective Comp	ulsory
	Computational Science and Engineering: Core Qualifica			
	Computational Science and Engineering: Core Qualifica			
	Mechatronics: Specialisation System Design: Elective Co			
	Mechatronics: Specialisation Intelligent Systems and Ro			
	Microelectronics and Microsystems: Specialisation Embe	eaded Systems: Elective Compulsory		

Course L0805: Embedded Sys	stams
	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
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 L0806: Embedded Sy	Course L0806: Embedded Systems	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0793: Semi	nars Computer Science and Ma	thematics			
Courses					
Title		Typ Hrs/wk CP			
Seminar Computational Mathemati	cs/Computer Science (L0797)	Seminar	2	2	
Seminar Computational Engineerin		Seminar	2	2	
Seminar Engineering Mathematics/	Computer Science (L1781)	Seminar	2	2	
Module Responsible	Prof. Karl-Heinz Zimmermann				
Admission Requirements	None				
Recommended Previous	Basic knowledge in Computer Science, Mathe	matics, and eventually Engineering Scien	ce.		
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	The students know who to acquire basic knowledge in a rudimentary field of Computer Science, Mathematics, or Engineering				
_	Science.				
Skills	The students are able to elaborate self-reliant	ly a rudimentary subfield of Computer Sc	ience, Mathematics, or	Engineering Science.	
Personal Competence	, and the second				
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84			
Credit points	6				
Examination	Presentation				
Examination duration and	Presentation 20 min and discussion 5 min.				
scale					
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Computer	Science: Compulsory		
Following Curricula	Computer Science: Core Qualification: Compu	Ilsory			
	General Engineering Science (English program	n, 7 semester): Specialisation Computer S	cience: Compulsory		
	Computational Science and Engineering: Core	Qualification: Compulsory			

Course I 0797: Seminar Com	Course L0797: Seminar Computational Mathematics/Computer Science		
	ourse 107377. Seminar Comparational Practical actions Science		
Тур	Seminar		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann, Dr. Jens-Peter Zemke, Dr. Mehwish Saleemi, Dr. Haibo Ruan		
Language	DE/EN		
Cycle	WiSe/SoSe		
Content	 Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics or computer science are proposed by the organizer Active participation in discussions. 		
Literature	Wird vom Seminarveranstalter bekanntgegeben.		

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

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

Module M0834: Comp	uternetworks and Internet Securi	ity		
Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Internet Se		Lecture	3	5
Computer Networks and Internet Se	•	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 read	thed the following learning results		
Professional Competence				
Knowledge	Students are able to explain important and com	mon Internet protocols in detail and classify	y them, in order t	o be able to analyse
	and develop networked systems in further studie	s and job.		
Skille	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
Skills	Students are able to analyse common internet pr	otocols and evaluate the use of them in ann	erent domains.	
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of high am	rount of professional knowledge and can ind	enendently learn	and understand it
7.10.07.07.77	Stadents can select relevant parts out of high an	oan or professional knowledge and can ma	ependenti, redin	and anderstand it.
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Computer Science	e: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Compulsor	У		
	Electrical Engineering: Core Qualification: Elective	' '		
	General Engineering Science (English program, 7		e: Elective Compu	lsory
	Computational Science and Engineering: Core Qu	' '		
	Technomathematics: Specialisation II. Informatics	s: Elective Compulsory		

Course L1098: Computer Net	·
	Lecture
Hrs/wk	
СР	
	Independent Study Time 108, Study Time in Lecture 42
	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann
Language	
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 Networks and Internet Security	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0731: Funct	cional Programming			
Courses				
Title		Тур	Hrs/wk	СР
Functional Programming (L0624)		Lecture	2	2
Functional Programming (L0625)		Recitation Section (large)	2	2
Functional Programming (L0626)		Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous	Discrete mathematics at high-school level			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students apply the principles, constructs, and simple to read Haskell programs and to explain Haskell syn errors in programs. They apply the fundamental da unit tests of functions and simple proof techniques for strategies.	tax as well as Haskell's read-eval-print l ta structures, data types, and type con	oop. They interpr structors. They e	et warnings and find mploy strategies for
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 justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.			
Personal Competence				
Social Competence	Students practice peer programming with varying programs orally. They communicate in English.	peers. They explain problems and solut	ions to their pee	r. They defend their
Autonomy	In programming labs, students learn under supervexercises, they develop solutions individually and ind		') the mechanics	of programming. In
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Computer Scienc	e: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 sen	nester): Specialisation Computer Science	e: Elective Compu	Isory
	Computational Science and Engineering: Specialisation	on I. Computer Science: Elective Compul	sory	
	Computational Science and Engineering: Specialisation	on Computer Science: Elective Compulso	ry	
	Technomathematics: Specialisation II. Informatics: El	ective Compulsory		

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

Course L0625: Functional Programming	
Тур	Recitation Section (large)
Hrs/wk	2
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 Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.

Course L0626: Functional Programming		
Тур	Recitation Section (small)	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Schupp	
Language	EN	
Cycle	WiSe	
Content	 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.	

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	None
Recommended Previous	
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematicians
	basic MATLAB knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	And during pure successfully, sedemon have reduced the following reducing results
· ·	Students are able to
Kilowieage	Students are able to
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding
	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,
	 justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
	select and execute a suitable solution approach for a given problem.
Personal Competence	
· ·	Students are able to
30ciai 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.
4	Production and a south
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	
	Written exam
Examination duration and	
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in
	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Elective Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core Qualification: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Elective Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
İ	Machanical Engineering, Cassislication Theoretical Machanical Engineering, Computatory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory

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

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

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP
Introduction to Control Systems (LC Introduction to Control Systems (LC	
Module Responsible	
Admission Requirements	
-	Representation of signals and systems in time and frequency domain, Laplace transform
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Children on varyaget diversis quaters habevier in time and frequency density and on in particular available available.
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties first and second order systems
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response a
	root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	
	Students can transform models of linear dynamic systems from time to frequency domain and vice versa They are simplest and appear the behavior of systems and extend to a system.
	 They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules
	They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
	They can calculate discrete-time approximations of controllers designed in continuous-time and use it for dig
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Parsanal Compotance	
Personal Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use
riaconomy	when solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	
Credit points	
Credit points	6 Written exam
Credit points Examination	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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 Product Development
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Covil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Sciences (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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmi and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmi and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Covil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering Sciences (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
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretic
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsory General Engineering Science
Credit points Examination 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 Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsor

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	to Control Systems	
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	ndependent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	Signals and systems	
	Linear systems, differential equations and transfer functions	
	First and second order systems, poles and zeros, impulse and step response	
	• Stability	
	Feedback systems	
	reeuback 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	
	a Introduction to Matlah Simulink Control toolbox	
	Introduction to Matlab, Simulink, Control toolbox Computer based exercises throughout the source.	
	Computer-based exercises throughout the course	
Literature		
Literature	Werner, H., Lecture Notes "Introduction to Control Systems"	
	G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009	
	K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010	
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010	

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0791: Comp	uter Architecture			
Courses				
Title		Тур	Hrs/wk	СР
Computer Architecture (L0793)		Lecture	2	3
Computer Architecture (L0794)		Project-/problem-based Learning	2	2
Computer Architecture (L1864)		Recitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Module "Computer Engineering"			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	This module presents advanced concepts from the discipline of various programming models is given, both for general-purp processors). Next, foundational aspects of the micro-architecture so-called pipelining and the methods used for the acceleration know concepts for dynamic scheduling, branch prediction, s hierarchies.	ose computers and for special of processors are covered. Here of instruction execution used in	Il-purpose made, the focus parthis context.	chines (e.g., signal rticularly lies on the The students get to
Skills	The students are able to describe the organization of processors. models. The students examine various structures of pipelined pro analyze them w.r.t. criteria like, e.g., performance or energy efficiency parallel computer architectures and are able to distinguish	ocessor architectures and are ab ciency. They evaluate different s	le to explain th	neir concepts and to emory hierarchies,
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group a	nd to present the results accordi	ngly.	
Autonomy	Students are able to acquire new knowledge from specific literate	ure and to associate this knowled	dge with other	classes.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 minutes, contents of course and 4 attestations from the PBL "	Computer architecture"		
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Spe	ecialisation Computer Science: E	lective Compu	Isory
Following Curricula	General Engineering Science (German program, 7 semester): Spe	ecialisation Computer Science: E	lective Compul	Isory
	Computer Science: Specialisation Computer and Software Engine	ering: Elective Compulsory		
	Computer Science: Specialisation Computer and Software Engine			
	Aircraft Systems Engineering: Specialisation Avionic and Embedd		-	
	Aircraft Systems Engineering: Specialisation Avionic and Embedd		-	
	General Engineering Science (English program, 7 semester): Spe	·	•	-
	General Engineering Science (English program, 7 semester): Spe			sory
	Computational Science and Engineering: Specialisation I. Comput		1	
	Computational Science and Engineering: Specialisation Compute			
	Microelectronics and Microsystems: Specialisation Embedded Sys	stems: Elective Compulsory		

Course L0793: Computer Arc	hitecture
Тур	Lecture
Hrs/wk	2
СР	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 Architecture	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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

Module M0562: Computability and Complexity Theory			
	Тур	Hrs/wk	СР
ory (L0166)	Lecture	2	3
ory (L0167)	Recitation Section (small)	2	3
Prof. Karl-Heinz Zimmermann			
None			
Discrete Algebraic Structures, Automata Theory, Logi	c, and Formal Language Theory.		
After taking part successfully, students have reached	the following learning results		
The students known the important machine mod	dels of computability, the class of p	artial recursive	functions, universal
computability, Gödel numbering of computations, th	e theorems of Kleene, Rice, and Rice-S	hapiro, the conce	ept of decidable and
undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence systems,			
Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.			
Students are able to solve specific problems alone or in a group and to present the results accordingly.			
Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes.			
Independent Study Time 124, Study Time in Lecture	56		
6			
Oral exam			
20 min			
General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory			
Computer Science: Core Qualification: Compulsory			
General Engineering Science (English program, 7 sem	nester): Specialisation Computer Science	: Elective Compu	Isory
Computational Science and Engineering: Specialisation	on I. Computer Science: Elective Compul	sory	
	·		
	ry (L0166) ry (L0167) Prof. Karl-Heinz Zimmermann None Discrete Algebraic Structures, Automata Theory, Logi After taking part successfully, students have reached The students known the important machine mode computability, Gödel numbering of computations, thundecidable sets, the word problems for semi-Thue Hilbert's 10-th problem, and the basic concepts of constitutions are able to investigate the computability of Students are able to solve specific problems alone or Students are able to acquire new knowledge from new Independent Study Time 124, Study Time in Lecture 16 Oral exam 20 min General Engineering Science (German program, 7 sem Computational Science and Engineering: Specialisatio Computational Science and Engineering: Specialisatio Computational Science and Engineering: Specialisations.	Typ Lecture ry (L0166) ry (L0167) Recitation Section (small) Prof. Karl-Heinz Zimmermann None Discrete Algebraic Structures, Automata Theory, Logic, and Formal Language Theory. After taking part successfully, students have reached the following learning results The students known the important machine models of computability, the class of p computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-S undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, Hilbert's 10-th problem, and the basic concepts of complexity theory. Students are able to investigate the computability of sets and functions and to analyze the constitutions are able to acquire new knowledge from newer literature and to associate the acquirence independent Study Time 124, Study Time in Lecture 56 Oral exam Omin General Engineering Science (German program, 7 semester): Specialisation Computer Science Computer Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Computational Science and Engineering: Specialisation I. Computer Science: Elective Computer Sci	Typ Hrs/wk Lecture 2 Recitation Section (small) 2 Prof. Karl-Heinz Zimmermann None Discrete Algebraic Structures, Automata Theory, Logic, and Formal Language Theory. After taking part successfully, students have reached the following learning results The students known the important machine models of computability, the class of partial recursive computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the conceundecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post corresellibert's 10-th problem, and the basic concepts of complexity theory. Students are able to investigate the computability of sets and functions and to analyze the complexity of computations are able to solve specific problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge will independent Study Time 124, Study Time in Lecture 56 Goral exam Omin General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Comput Computer Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Comput Computational Science and Engineering: Specialisation I. Computer Science: Elective Computsory Computational Science and Engineering: Specialisation Computer Science: Elective Computsory

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

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

Module M0732: Software Engineering				
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			
	None			
Recommended Previous	Automata theory and formal languages			
Knowledge	Procedural programming or Functional programmin	g		
	 Object-oriented programming, algorithms, and data 	structures		
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	Anter taking part successfully, stadents have redefied the	Tonowing rearring results		
·	Students explain the phases of the software life cyc	le. describe the fundamental ter	minology and co	oncepts of software
	engineering, and paraphrase the principles of structured s			
	of existing large-scale systems. They write test cases	for different test strategies and d	evise specification	ons or models using
	different notations, and critique both. They explain sim	ple design patterns and the majo	r activities in re	quirements analysis,
	maintenance, and project planning.			
Skills	For a given task in the software life cycle, students ide	ntify the corresponding phase and	select an appro	priate method. They
	For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. They choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and find			
	errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interface			
	specifications.			
Personal Competence				
Social Competence	Students practice peer programming. They explain problems and solutions to their peer. They communicate in English.			
Autonomy	Using on-line quizzes and accompanying material for self study, students can assess their level of knowledge continuously and			
	adjust it appropriately. Working on exercise problems, they receive additional feedback.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
_		er): Specialisation Computer Science	e: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory			
	Computational Science and Engineering: Specialisation I.	·	-	
	Computational Science and Engineering: Specialisation Co	·	ory	
	Technomathematics: Specialisation II. Informatics: Electiv	e Compulsory		

Course L0627: Software Eng	ineering
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	SoSe
Content	
	 Software Life Cycle Models (Waterfall, V-Model, Evolutionary Models, IncrementalModels, Iterative Models, Agile Processes) Requirements (Elicitation Techniques, UML Use Case Diagrams, Functional and Non-Functional Requirements) Specification (Finite State Machines, Extended FSMs, Petri Nets, Behavioral UML Diagrams, Data Modeling) Design (Design Concepts, Modules, (Agile) Design Principles) Object-Oriented Analysis and Design (Object Identification, UML Interaction Diagrams, UML Class Diagrams, Architectural Patterns) Testing (Blackbox Testing, Whitebox Testing, Control-Flow Testing, Data-Flow Testing, Testing in the Large) Maintenance and Evolution (Regression Testing, Reverse Engineering, Reengineering) Project Management (Blackbox Estimation Techniques, Whitebox Estimation Techniques, Project Plans, Gantt Charts, PERT Charts)
Literature	Kassem A. Saleh, Software Engineering, J. Ross Publishing 2009.

Course L0628: Software Engineering	
Тур	Recitation Section (small)
Hrs/wk	2
СР	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
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2	3
Module Responsible			-	-
Admission Requirements				
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Plan and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
	 explain the differences between Economics and important definitions from the field of Management explain the most important aspects of and goals in projects describe and explain basic business functions as organization and human ressource management, info explain the relevance of planning and decision muncertainty, and explain some basic methods from m state basics from accounting and costing and selected 	Management and name the mos production, procurement and sommation management, innovation aking in Business, esp. in situal athematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain manageme nd marketing
Skills	Students are able to analyse business units with respect to out an Entrepreneurship project in a team. In particular, the		ojectives, strateg	ies etc.) and to ca
	analyse Management goals and structure them appropriate analyse organisational and staff structures of compains apply methods for decision making under multiple obtained analyse production and procurement systems and Butainalyse and apply basic methods of marketing select and apply basic methods from mathematical fire apply basic methods from accounting, costing and contains	nies jectives, under uncertainty and un siness information systems nance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an entre to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project.	preneurship project and write a co	oherent report or	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and	several written exams during the semester			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula				
	General Engineering Science (German program, 7 semester	· ·		ory
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester			ary.
	General Engineering Science (German program, 7 semester			л у
	General Engineering Science (German program, 7 semester			ring: Compulsory
	General Engineering Science (German program, 7 sem		_	
	Compulsory	. ,	3	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (German program, 7 seme Engineering: Compulsory Constal Engineering Science (German program 7 see			•
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanic	aı Engineering,	rocus Materials
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester Engineering: Compulsory): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani
	General Engineering Science (German program, 7 semesterand Production: Compulsory	r): Specialisation Mechanical Eng	ineering, Focus F	Product Developme
	General Engineering Science (German program, 7 semes	ster): Specialisation Mechanical I	Engineering, Foo	us Energy System

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory
Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course L	0882:	Management Tutorial
Torr		situation Costion (loves)

Typ Recitation Section (large)

Hrs/wk 2

CP 3

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Lecturer Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek

Language DE

Cycle \

wiSe/SoSe

Content

In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.

If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on se selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction to Management			
Тур	Lecture		
Hrs/wk	3		
CP :	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius		
-	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 		
	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.		
Į į	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.		
N	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

Module M1269: Lab C	yber-Physical Systems
Courses	
Title	Typ Hrs/wk CP
Lab Cyber-Physical Systems (L1740	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 integrated with their surrounding environment, via sensors, A/D and D/A converters, and actors. Due to their particular application areas, highly specialized sensors, processors and actors are common. Accordingly, there is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation, hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab's experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors.
Skills Personal Competence	After successful attendance of the lab, students are able to develop simple CPS. They understand the interdependencies between a CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D converters, digital processors, D/A converters and actors. The lab enables students to compare modelling approaches, to evaluate their advantages and limitations, and to decide which technique to use for a concrete task. They will be able to apply these techniques to practical problems. They obtain first experiences in hardware-related software development, in industry-relevant specification tools and in the area of simple control applications.
•	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Jocial Competence	stadents are asia to some similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written elaboration
Examination duration and	Execution and documentation of all lab experiments
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory
Following Curricula	Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory
	Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory
	Mechatronics: Specialisation System Design: Elective Compulsory
	Mechatronics: Technical Complementary Course: Elective Compulsory

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

Module 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-oriented programming, algorithms, and da	ata structures		
Knowledge	Procedural programming	ica seración es		
	Experience in using tools related to operating sys	tems such as editors, linkers, compile	ers	
	Experience in using C-libraries	, , , , , ,		
	,			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the			
	process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads,			
	conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three			
	different scheduling algorithms.			
Skills	Students are able to use the POSIX libraries for concurr	ent programming in a correct and eff	icient wav. Thev a	re able to judge the
	efficiency of a scheduling algorithm for a given scheduling task in a given environment.			
		3 3		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science	e: Elective Compu	ulsory
Following Curricula	Computer Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Computer Science	e: Elective Compu	Isory
	Computational Science and Engineering: Specialisation	·	-	
	Computational Science and Engineering: Specialisation	·	ory	
	Technomathematics: Specialisation II. Informatics: Elect	ive Compulsory		

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

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

Module M1062: Math	ematical Statistics			
Courses				
Title		Тур	Hrs/wk	СР
Mathematical Statistics (L1339)		Lecture	3	4 2
Mathematical Statistics (L1340)	Due 6 Make 15 - Management	Recitation Section (small)	1	Z
	Prof. Natalie Neumeyer			
Admission Requirements Recommended Previous				
Knowledge	Mathematical Stochastics			
	Measure Theory and Stochastics			
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence Knowledge	Students can describe basic concepts in Math for construction of estimators, optimal unf sufficiency and completeness and their approximation confidence domains and test families. They are Students can discuss logical connections between the help of examples. They know proof strategies and can reproduce	falsified estimators, optimal tests for plication to estimation and test proble e able to explain them using appropriate ween these concepts. They are capable	parametric prob ms, tests in nor examples.	ability distributions, mal distribution and
Skills	 Students can model problems in Mathematical are capable of solving them by applying estab Students are able to discover and verify furthe For a given problem, the students can devel results. 	lished methods. er logical connections between the conce	pts studied in the	e course.
Personal Competence Social Competence	Students are able to work together in teams. T In doing so, they can communicate new concedesign examples to check and deepen the unconcedes.	epts according to the needs of their coop		
Autonomy	 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 hyproblems. 			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
	Written exam			·
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 se			•
Following Curricula	General Engineering Science (English program, 7 sen		•	Isory
	Computational Science and Engineering: Specialisation	·	ory	
	Technomathematics: Specialisation I. Mathematics: E	Elective Compulsory		

Course L1339: Mathematical	Statistics
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE/EN
Cycle	SoSe
Content	 Substitution and Maximum-Likelihood methods for construction of estimators Optimal unfalsified estimators Optimal tests for parametric probability distributions (Neymann-Pearson theory) Sufficiency and completeness and their application to estimation and test problems Tests in normal distribution (e.g. Student's test) Confidence domains and test families
Literature	 V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley. L. Wasserman (2010). All of statistics: A concise course in statistical inference. Springer. H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner.

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

Specialization Mechanical Engineering

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

- 1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.
- 2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.
- 3) In-depth knowledge in Engineering applications, especially in the selected subject area of 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

Indigenent Design and 3D-CAD (L0268) Identified Design Project I (L0695) Identified					
Indigenent Design and 3D-CAD (L0268) Identified Design Project I (L0695) Identified	Module M0598: Mecha	anical Engineering: Design			
Autonomy Stiment Design Project I (L0693) Alter passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, dismentable shallow for design and solve engineering design tasks systamtically and solution-oriented, dimension (calculate) used competence Social Competence Social Competence Autonomy Students are able Autonomy Students are able To estimate their level of knowledge using a ctivating methods within the lectures (e.g. with clickers), To estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), To estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),	Courses				
Atter passing the module, students are able to: Project Design Project (L0695) Project Design Methodology (L0267)	Title		Тур	Hrs/wk	СР
Autonomy Autonomy Autonomy Science Autonomy Autonomy Autonomy Students are able Autonomy Autonomy Students are able Autonomy Students are able Autonomy Autonomy Students are able To describe basics of 3D CAD, Autonomy Autonomy Students are able To describe basic of 3D CAD, Autonomy 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.	Embodiment Design and 3D-CAD (L	0268)	Lecture	2	1
Module Responsible Prof. Dieter Krause duministing Requirements Prof. Dieter Krause duministon Recommended Previous Knowledge Production Engineering Design Mechanics Fundamentals of Materials Science Production Engineering Prof. Dieter Recommended Previous After taking part successfully, students have reached the following learning results Professional Competence Recommended Previous After passing the module, students are able to: • explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, describe basics of 3D CAD, explain basics methods of engineering designing. Skills After passing the module, students are able to: • independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. Personal Competence Social Competence **After passing the module, students are able to: • develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course.	Mechanical Design Project I (L0695)				
Module Responsible Prof. Dieter Krause Mome Mome	Mechanical Design Project II (L0592				
Recommended Previous Knowledge Fundamentals of Mechanical Engineering Design Mechanics Fundamentals of Materials Science Production Engineering Production Engineering After taking part successfully, students have reached the following learning results Professional Competence Knowledge After passing the module, students are able to: explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, describe basics of 3D CAD, explain basics methods of engineering designing. Skills After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. Personal Competence Social Competence After passing the module, students are able to: develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. Autonomy Students are able to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),			Project-/problem-based Learning	2	1
Fundamentals of Mechanica Fundamentals of Mechanical Engineering Design	-				
Knowledge Fundamentals of Mechanics Mechanics Mechanics Fundamentals of Materials Science Fundamentals of Materials Science Fundamentals of Materials Science Production Engineering		None			
Mechanics Fundamentals of Materials Science Production Engineering After taking part successfully, students have reached the following learning results Fofessional Competence Knowledge After passing the module, students are able to: explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, describe basics of 3D CAD, explain basics methods of engineering designing. Skills After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. Personal Competence Social Competence After passing the module, students are able to: develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. Autonomy Autonomy to Mechanica Materials Science After taking part successfully, students have reached the following learning results in the lectures (e.g. with clickers),		• Fundamentals of Mechanical Engineering Design			
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	Autonomy	Students are able			
		to estimate their level of knowledge using activation	iting methods within the lectures (e.g. wi	ith clickers),	
To solve engineering design tasks systematically.		• To solve engineering design tasks systematically.			
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Workload in Hours Independent Study Time 40, Study Time in Lecture 140 Credit points 6					
Examination Written exam	•				
xamination duration and 180					
scale		100			
Assignment for the General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory		General Engineering Science (German program): Specia	lisation Energy and Environmental Engine	ering: Compu	sorv
Following Curricula General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory	-				,
General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory				-	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory				-	ory
General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory		General Engineering Science (German program, 7 seme	ster): Specialisation Biomedical Engineer	ing: Compulso	ory
General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory		General Engineering Science (German program, 7 seme	ster): Specialisation Energy and Envirom	ental Enginee	ring: Compulsory
Energy and Environmental Engineering: Core Qualification: Compulsory		Energy and Environmental Engineering: Core Qualification	on: Compulsory		
General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory	!	General Engineering Science (English program): Special	sation Energy and Enviromental Enginee	ring: Compuls	sory
General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory	I	General Engineering Science (English program): Speciali	sation Mechanical Engineering: Compuls	ory	
General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	Ì				
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory		General Engineering Science (English program): Special	sation Biomedical Engineering: Compuls	ory	
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			- · ·	•	ry

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

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

Course L0267: Team Project	Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides 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

	amentals of Materials Science			
Courses				
	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Typ Lecture Lecture	Hrs/wk 2 2	CP 2 2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible				
Admission Requirements	None			
Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. Till for materials and can identify relevant approaches for chaphenomena back to the underlying physical and chemical laws	cally the issues of atomic some students know about the aracterizing specific proper	tructure, microstructure key aspects of char	ure, phase diagram acterization metho
Skills	The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy	_			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	, ,			
Examination				
Examination duration and				
scale	166 11111			
Assignment for the	General Engineering Science (German program): Specialisation	Energy and Environmental	Engineering: Comput	
-	General Engineering Science (German program). Specialisation	Energy and Environmental		sorv
Following Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: (sory
Following Curricula	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation		Compulsory	sory
Following Curricula	General Engineering Science (German program): Specialisation	Biomedical Engineering: C	Compulsory Compulsory	sory
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Course L1085: Fundamentals	s of Materials Science I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course L0506: Fundamentals	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

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

Module M0680: Fluid	Dynamics			
Courses				
Title Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering	mechanics and thermodynamics.		
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results		
Professional Competence	3,4	<u> </u>		
Knowledge	Students will have the required sound knowledge to expla Students can scientifically outline the rationale of flow phys performance analysis and the prediciton of fluid engineering	ics using mathematical models a		
Skills	Students are able to apply fluid-engineering principles and enables the student to carry out all necessary theoretical escientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develo	p solution strategies.		
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program): Specialisati	on Mechanical Engineering: Com	pulsory	
Following Curricula	General Engineering Science (German program): Specialisati	on Biomedical Engineering: Comp	oulsory	
	General Engineering Science (German program): Specialisati	on Naval Architecture: Compulso	ry	
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engin	eering: Compulso	ry
	General Engineering Science (German program, 7 semester)			ry
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (English program): Specialisation		-	
	General Engineering Science (English program): Specialisation		-	
General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory			2/	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			,
	Computational Science and Engineering: Specialisation Engin			
	Mechanical Engineering: Core Qualification: Compulsory	3	,	
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

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

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

Module M0960: Mech	anics IV (Kinetics II, Oscillations, Analy	ytical Mechanics, Multibo	dy Systems	5)
Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
•	The students can			
	 describe the axiomatic procedure used in mechan 	nical contexts;		
	 explain important steps in model design; 			
	 present technical knowledge. 			
Skills	The students can			
Skiiis	The students cur			
	explain the important elements of mathematical	/ mechanical analysis and model form	mation, and appl	y it to the context of
	their own problems;			
	 apply basic methods to engineering problems; 			
	 estimate the reach and boundaries of the method 	s and extend them to be applicable to	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 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	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program): Specia	lisation Mechanical Engineering: Com	pulsory	
Following Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia			
	General Engineering Science (German program, 7 seme			orv
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme			,
	General Engineering Science (English program): Speciali			
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	General Engineering Science (English program): Speciali	3 3 1	•	
	General Engineering Science (English program, 7 semes			rv
	General Engineering Science (English program, 7 semes			-
	General Engineering Science (English program, 7 semes	- · ·		' 7
	Mechanical Engineering: Core Qualification: Compulsory	•	Compuisory	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	and Floating Committee		
	Technomathematics: Specialisation III. Engineering Scient	, ,	Communication	
	Theoretical Mechanical Engineering: Technical Complem	lentary Course Core Studies: Elective	compuisory	

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

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

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

Module M0956: Meas	urement Technology for Mechanical	and Process Engineers		
Courses				
Title Practical Course: Measurement and Control Systems (L1119) Measurement Technology for Mechanical and Process Engineers (L1116)		Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	CP 2 3
	anical and Process Engineers (L1118)	Recitation Section (large)	1	1
Module Responsible Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrica	l engineering		
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge				
	They can outline the most important measuring m Temperature, mechanical quantities, Flow, Time, Fr		to be maesured (Electrical Quantities
	They can describe important methods of chemical A	nalysis (Gas Sensors, Spectroscopy, Gas	Chromatography)	
Skills	S 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 place the issues into the right context and application		gy and solution a	pproaches as well a
Personal Competence Social Competence	Students can arrive at work results in groups and do	ocument them in a common report.		
Autonomy	Students are able to familiarize themselves with nev	w measurement technologies.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	2 70		
Credit points	6			
Examination	Written exam			
Examination duration and	105 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 se		_	
Following Curricula	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se		neering: Compulso	ory
	Energy and Environmental Engineering: Core Qualifi General Engineering Science (English program, 7 se		amontal Engineer	ing: Compulsory
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program, 7 se	- · ·		-
	Mechanical Engineering: Core Qualification: Compul		g. copuiso	. ,
	Mechatronics: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory	,		
	3 3 . 4			

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

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

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

Module M0865: Funda	amentals of Production and	Quality Management		
Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (Li	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 I	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the contents of the lecture of the module.			
Skills	Students are able to apply the methods and models in the module to industrial problems.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Time	ne in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory		Compulsory	
Following Curricula	General Engineering Science (English pr	ogram, 7 semester): Specialisation Mechanical En	gineering: Elective C	Compulsory
	Logistics and Mobility: Specialisation Eng	gineering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualificati	ion: Elective Compulsory		

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

Course L0926: Quality Manag	gement
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe 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 M0610: Electr	ical Machines and Actuators			
Courses				
Title Electrical Machines (L0293) Electrical Machines (L0294)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular complexe number	s, integrals, differentials		
Knowledge	Basics of electrical engineering and mechanical engine	eering		
Educational Objectives	After taking part successfully, students have reached t	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 standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.			
Skills	Students arw able to calculate two-dimensional elections they apply the usual methods of the design auf elections.		romagnetic circu	its with air gap. For
	They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.			
Personal Competence Social Competence Autonomy	none Students are able independently to calculate electric athe operational performance of electric machines from and characteristic curves.		-	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points				
Examination	Written exam			
Examination duration and	120 Minutes		_	
scale				
Assignment for the	General Engineering Science (German program, 7 sem			
Following Curricula	General Engineering Science (German program, 7 sem		-	
	General Engineering Science (German program, 7 sem Electrical Engineering: Core Qualification: Elective Con		ring: Elective Co	mpuisory
	Energy and Environmental Engineering: Core Qualifica			
	General Engineering Science (English program, 7 seme	• •	mental Engineeri	ng: Compulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engine	ering: Elective C	ompulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Electrical Engineer	ing: Elective Con	npulsory
	Computational Science and Engineering: Specialisation		Isory	
	Logistics and Mobility: Specialisation Engineering Scien			
	Mechanical Engineering: Core Qualification: Elective Co	ompulsory		
	Mechatronics: Core Qualification: Compulsory			

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

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

Module M0934: Adva	nced Materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterization	on (L1087)	Lecture	2	2
Advanced Materials Design (L1091)	Lecture	2	2
Advanced Materials Design (L1092		Recitation Section (large)	2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence Social Competence	The students are able to present solutions to specialists and to develop ideas further.			
Autonomy	The students are able to • assess their own strengths and weaknesses. • define tasks independently.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): 9	Specialisation Mechanical Engine	eering: Elective (Compulsory
-	General Engineering Science (English program, 7 semester): S		-	
	Mechanical Engineering: Core Qualification: Elective Compulso	·		. ,

Course L1087: Advanced Ma	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 Materials Design	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE/EN
Cycle	SoSe
Content	
Literature	Vorlesungsunterlagen

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

Focus Biomechanics

Students with the emphasis Biomechanics get in addition to their core engineering skills, a basic understanding of the medical field focusing on fracture healing and implants. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area.

	nced Mechanical Engineerir	ig Design			
Courses					
litle .			Тур	Hrs/wk	СР
dvanced Mechanical Engineering			Lecture	2	2
dvanced Mechanical Engineering	=		Recitation Section (large)	2	1
dvanced Mechanical Engineering			Lecture	2	2
dvanced Mechanical Engineering	Design I (L0263)		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous		in a cultura De circa			
Knowledge	Fundamentals of Mechanical Eng	ineering besign			
	Mechanics				
	Fundamentals of Materials Science Fundamentals of Materials Science	ce			
	Production Engineering				
Educational Objectives	After taking part successfully, students	have reached the following	ng learning results		
Professional Competence			<u> </u>		
	After passing the module, students are	able to:			
Knowiedge	Arter passing the module, students are	able to.			
	explain complex working principl	es and functions of mach	ine elements and of basic ele	ements of fluidics,	
	explain requirements, selection of	riteria, application scena	rios and practical examples of	of complex machin	ne elements,
	indicate the background of dimer	nsioning calculations.			
Skills	After passing the module, students are	able to:			
	accomplish dimensioning calcula	tions of covered machine	elements		
	transfer knowledge learned in the			vina skills)	
	recognize the content of technical			vilig skilis),	
			c sketches,		
	 evaluate complex designs, techn 	ically.			
Personal Competence					
Social Competence					
•	Students are able to discuss tech	inical information in the le	ecture supported by activatir	ig methods.	
Autonomy	,				
Autonomy	Students are able to independent	tly deepen their acquired	knowledge in exercises.		
	Students are able to acquire ad-	ditional knowledge and t	o recapitulate poorly unders	tood content e.g.	. by using the vid
	recordings of the lectures.				
Wedderd by Herre	Index and art Study Time CO. Study Time	- in Lankson 112			
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Credit points					
	Written exam				
Examination duration and					
scale					
	General Engineering Science (German p		Mechanical Engineering, Focu	is Energy Systems	
_		program): Specialisatio			
_	General Engineering Science (German			Focus Aircraft Sy	
_	Compulsory		on Mechanical Engineering,		ystems Engineerin
_	Compulsory General Engineering Science (German	program): Specialisation	on Mechanical Engineering,		ystems Engineerin
_	Compulsory	program): Specialisation	on Mechanical Engineering,		ystems Engineerin
_	Compulsory General Engineering Science (German		on Mechanical Engineering, Mechanical Engineering, Foc	us Materials in E	ystems Engineerin
_	Compulsory General Engineering Science (German Compulsory	orogram): Specialisation N	on Mechanical Engineering, Mechanical Engineering, Focu Mechanical Engineering, Focu	us Materials in En	ystems Engineering Science
_	Compulsory General Engineering Science (German Compulsory General Engineering Science (German p	orogram): Specialisation N	on Mechanical Engineering, Mechanical Engineering, Focu Mechanical Engineering, Focu	us Materials in En	ystems Engineering Science
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Compulsory

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory

Naval Architecture: Core Qualification: Compulsory

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	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, akt
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	1

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

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

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

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	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeletal system. The students can describe the basic macroscopy and microscopy of those systems.			
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; the can explain the relevance of structures and their functions in the context of widespread diseases.			
Personal Competence				
•	The students can participate in current discussions in biomedical research and medicine on a professional level.			
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquithe relevant knowledge themselves.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
Following Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory			
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory			
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Course L0384: Introduction t	o Anatomy	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study T	ime 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange	
Language		
Cycle		
Content	General Anatomy	
	1 st week:	The Eucaryote Cell
	2 nd week:	The Tissues
	3 rd week:	Cell Cycle, Basics in Development
	4 th week:	Musculoskeletal System
	5 th week:	Cardiovascular System
	6 th week:	Respiratory System
	7 th week:	Genito-urinary System
	8 th week:	mmune 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, 16. Auflage, Thieme Verlag Stuttgart, 2012

and Systems (L0432) and Systems (L0433)	Typ Lecture	Hrs/wk	
	Lecture		CP
and Systems (L0433)		3	4
	Recitation Section (small)	2	2
Module Responsible Prof. Gerhard Bauch			
mission Requirements None			
ecommended Previous Mathematics 1-3			
Knowledge The modul is an introduction to the theory of signals and	systems. Good knowledge in maths	as covered by the	e moduls Mathemati
1-3 is expected. Further experience with spectral transf	formations (Fourier series, Fourier tr	ansform, Laplace	transform) is usefu
but not required.			
The state of the s	- f-ll-using languages		
Educational Objectives After taking part successfully, students have reached the	e following learning results		
fessional Competence			
Knowledge The students are able to classify and describe signals are	· · ·	-	-
theory. They are able to apply the fundamental transfor			
can describe and analyse deterministic signals and sys understand the effects in time domain and image dom			
discrete-time signal.	iam which are caused by the trails	tion of a continu	lous-time signal to
Skills The students are able to describe and analyse determini	istic signals and linear time-invariant	t evetame using m	nethods of signal and
system theory. They can analyse and design basic s			
response, stability, linearity etc They can assess the im			
Personal Competence	pace of 211 systems on the signal pro	percies in cime ai	ia irequeriey dorrian
Social Competence The students can jointly solve specific problems.			
Autonomy The students are able to acquire relevant informatio	on from appropriate literature sour	res They can c	ontrol their level o
knowledge during the lecture period by solving tutorial p			ontrol their level o
Workload in Hours Independent Study Time 110, Study Time in Lecture 70	, objection (1990)		
Credit points 6			
Examination Written exam			
mination duration and 90 min			
scale			
Assignment for the General Engineering Science (German program): Special			
Following Curricula General Engineering Science (German program): Special			
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General Engineering Science (German program, 7 semes			
General Engineering Science (German program, 7 semes			ory
General Engineering Science (German program, 7 semes	ster): Specialisation Biomedical Engir	neering: Compulso	ory
General Engineering Science (German program, 7 s	semester): Specialisation Mechanica	al Engineering, F	ocus Biomechanics
Compulsory			
General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical	Engineering, Foc	us Energy Systems
Compulsory			
General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical	Engineering, Foo	cus Aircraft System
Engineering: Compulsory			
General Engineering Science (German program, 7	semester): Specialisation Mechanic	cal Engineering,	Focus Materials i
Engineering Sciences: Compulsory			
General Engineering Science (German program, 7 s	semester): Specialisation Mechanic	al Engineering, I	Focus Mechatronics
Compulsory			
General Engineering Science (German program, 7 semes	ster): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechanica
Engineering: Compulsory			
Computer Science: Core Qualification: Compulsory			
Electrical Engineering: Core Qualification: Compulsory	anting Civil and Environmental Environ		
General Engineering Science (English program): Specialis			ory
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General Engineering Science (English program 7 semest	,. specialisation computer science		
General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest	ter): Specialisation Process Engineeri	na: Compulsory	
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General Engineering Science (English program, 7 semest	ter): Specialisation Bioprocess Engine ter): Specialisation Biomedical Engine	eering: Compulsor	ry
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Compulsory	ı
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems	i
Engineering: Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	i
Sciences: Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:	i
Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	i
Engineering: Compulsory	i
Computational Science and Engineering: Core Qualification: Compulsory	i
Computational Science and Engineering: Core Qualification: Compulsory	i
Mechatronics: Core Qualification: Compulsory	i
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

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

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

Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Module M1279: MED I	II: Introduction to Biochemist	ry and Molecular Biology		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and Mo	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	re reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	explain how genetic information is compared to the second control of the second con	oded in the DNA;		
	explain the connection between DNA	A and proteins;		
Skills	The students can			
	• recognize the importance of melecul	ar parameters for the course of a disease;		
	describe selected molecular-diagnos	•		
	explain the relevance of these proce	•		
	explain the relevance of these proces	dates to some discuses		
Personal Competence				
Social Competence	The students can participate in discussions	in research and medicine on a technical level.		
Autonomy	The students can develop understanding of	f topics from the course, using technical literati	ure, by themselves.	
Workload in Hours	Independent Study Time 62, Study Time in	Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Specialisation Biomedical Er	ngineering: Compulsor	у
Following Curricula		program, 7 semester): Specialisation Mecha	nical Engineering, Fo	cus Biomechanics:
	Compulsory			
	Electrical Engineering: Specialisation Medic	**		
		rogram, 7 semester): Specialisation Mechai	nical Engineering, Fo	cus Biomechanics:
	Compulsory			
	Mechanical Engineering: Specialisation Biol	ram, 7 semester): Specialisation Biomedical En	gineering: Compuisory	,
	* · ·	nagement and Business Administration: Elective	e Compulsory	
		ficial Organs and Regenerative Medicine: Electiv		
		lical Technology and Control Theory: Elective C		
		lants and Endoprostheses: Elective Compulsor		
	Technomathematics: Specialisation III. Eng		,	

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

Module M0730: Comp	outer Engineering			
Courses				
Title	Typ Hrs/wk CP			
Computer Engineering (L0321)	Typ Hrs/wk CP Lecture 3 4			
Computer Engineering (L0324)	Recitation Section (small) 1 2			
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level			
	programming down to gates. The module includes the following topics:			
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks			
	Sequential logic: Flip-flops, automata, systematic hardware design			
	Technological foundations			
	Computer arithmetic: Integer addition, subtraction, multiplication and division			
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining			
	Memories: Memory hierarchies, SRAM, DRAM, caches			
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses			
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physica			
	composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a			
	collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers o			
	today's computing systems - from gates and circuits up to complete processors.			
	After successful completion of the module, the students are able to judge the interdependencies between a physical compute			
	system and the software executed on it. In particular, they shall understand the consequences that the execution of software has			
	on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate			
	the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.			
Barranal Compatones				
Personal Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.			
30ciai Competence	Stadents are able to solve similar problems alone or in a group and to present the results accordingly.			
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
	6 Written exam			
Examination				
Examination	Written exam			
Examination Examination duration and scale	Written exam			
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Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Eng			
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Dioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrogram Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computery Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computery Science (English program, 7 seme			

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M1333: BIO I:	Implants and Fracture Healing			
Courses				
Title	Typ Hrs/wk CP			
Implants and Fracture Healing (L03	376) Lecture 2 3			
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence.			
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.			
Skille	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.			
Skills	The statents can determine the forces acting within the number body under quasi-static situations under specific assumptions.			
Personal Competence				
Social Competence	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.			
Autonomou	The shiplants can in average solve basic proposition modeling heals for the colorabian of interval forces			
Autonomy	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan	cs:		
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory			
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			
	Orientierungsstudium: Core Qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			
	recinionationatics. Speciaisation in: Engineering Science: Elective Compusory			

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

Module M0662: Nume	erical Mathematics I				
Courses					
Title	1	ур	Hrs/wk	СР	
Numerical Mathematics I (L0417)		ecture	2	3	
Numerical Mathematics I (L0418)	T	ecitation Section (small)	2	3	
Module Responsible					
Admission Requirements					
Recommended Previous	 Mathematik I + II for Engineering Students (german or engli 	sh) or Analysis & Linear Alge	bra I + II for Te	chnomathematicians	
Knowledge	basic MATLAB knowledge				
,	After taking part successfully, students have reached the following	learning results			
Professional Competence	Chudanta ara abla ta				
Knowieage	Students are able to				
	 name numerical methods for interpolation, integration, leas 	t squares problems, eigenva	lue problems, n	onlinear root finding	
	problems and to explain their core ideas,				
	 repeat convergence statements for the numerical methods, 				
	explain aspects for the practical execution of numerical met	hods with respect to comput	ational and stor	age complexitx.	
CL "II					
Skills	Students are able to				
	implement, apply and compare numerical methods using Ma	ATLAB,			
	 justify the convergence behaviour of numerical methods with 	h respect to the problem and	solution algori	thm,	
	select and execute a suitable solution approach for a given	problem.			
Personal Competence					
	Students are able to				
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
	work together in heterogeneously composed teams (i.e., te				
	explain theoretical foundations and support each other with	practical aspects regarding t	the implementa	tion of algorithms.	
Autonomy	Students are capable				
	- to coope whether the corporation the contice and prostice a	vecusione and batter column is	adicide alle as in		
		 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. 			
	to assess their marriadar progess and, it necessary, to ask q	acononio ana ocen neipi			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination					
Examination duration and	90 minutes				
scale					
Assignment for the				France Makadala in	
Following Curricula	General Engineering Science (German program, 7 semester) Engineering Sciences: Compulsory	: Specialisation Mechanical	Engineering,	Focus Materials in	
	General Engineering Science (German program, 7 semester): Spec	ialisation Biomedical Enginee	erina: Compulso	rv	
	General Engineering Science (German program, 7 semester):	_		-	
	Compulsory	•	3 3.		
	General Engineering Science (German program, 7 semester): Spec	cialisation Mechanical Engine	ering, Focus Th	eoretical Mechanical	
	Engineering: Elective Compulsory				
	General Engineering Science (German program, 7 semester): Spec	cialisation Mechanical Engine	ering, Focus Th	eoretical Mechanical	
	Engineering: Compulsory				
	Bioprocess Engineering: Specialisation A - General Bioprocess Engi	, ,	/		
	Computer Science: Specialisation Computational Mathematics: Ele Electrical Engineering: Core Qualification: Elective Compulsory	ctive Compulsory			
	General Engineering Science (English program, 7 semester): Speci	alication Computer Science:	Compulsory		
	General Engineering Science (English program, 7 semester): Speci	·		erials in Engineering	
	Sciences: Compulsory				
	General Engineering Science (English program, 7 semester): Speci	alisation Biomedical Enginee	ring: Compulsor	y	
	General Engineering Science (English program, 7 semester):				
	Compulsory				
	General Engineering Science (English program, 7 semester): Spec	ialisation Mechanical Engine	ering, Focus Th	eoretical Mechanical	
	Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Spec	ialisation Mechanical Engine	ering, Focus Th	eoretical Mechanical	
	Engineering: Elective Compulsory	.laan.			
	Computational Science and Engineering: Core Qualification: Computational Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering:		24		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialis		у		
	Process Engineering: Specialisation Process Engineering: Elective (

Course L0417: Numerical Mathematics I			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne		
Language	DE/EN		
Cycle	WiSe		
Content	tent 1. Error analysis: Number representation, error types, conditioning and stability 2. Interpolation: polynomial and spline interpolation 3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, ada quadrature, difference formulas 4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning 5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular decomposition, regularization 6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm 7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Content of Newton methods for systems		
Literature	 Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer 		

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

Module M0833: Intro	duction to Control Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Systems (Li	0654)	Lecture	2	4
Introduction to Control Systems (Li	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and fr	equency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence		The following learning results		
Knowledge				
	Students can represent dynamic system beha	vior in time and frequency domain, and	can in particular	explain properties of
	first and second order systems			
	 They can explain the dynamics of simple cont root locus 	rol loops and interpret dynamic propertie	es in terms of fre	quency response and
	They can explain the Nyquist stability criterior	and the stability margins derived from i	t	
	They can explain the role of the phase margin			
	They can explain the way a PID controller affe			
	They can explain issues arising when controlle			digitally
CI-III-				
Skills	Students can transform models of linear dynamics	nic systems from time to frequency dom	ain and vice vers	sa .
	They can simulate and assess the behavior of	systems and control loops		
	They can design PID controllers with the help			
	They can analyze and synthesize simple contr			
	 They can calculate discrete-time approxim implementation 	ations of controllers designed in con	tinuous-time an	d use it for digital
	They can use standard software tools (Matlab)	Control Toolbox, Simulink) for carrying o	ut these tasks	
	- They can use standard software tools (Mattab	control rootbox, simulink, for currying o	at these tasks	
Personal Competence				
	Students can work in small groups to jointly solve ted			
Autonomy	· ·	rces (lecture notes, software document	ation, experime	nt guides) and use it
	when solving given problems.			
	They can assess their knowledge in weekly on-line to	sts and thereby control their learning pr	ogress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the				
Following Curricula	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se			эгу
	General Engineering Science (German program, 7 se	•		
	General Engineering Science (German program, 7 se			у
	General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engin	eering: Compuls	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 se	mester): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	al Engineering,	Focus Mechatronics:
	Compulsory			- 5:
	General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanica	ii Engineering,	-ocus Biomechanics:
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Fo	cus Aircraft Systems
	Engineering: Compulsory	. ,	3	,
	Gonoral Engineering Science (Gorman program			
	General Engineering Science (Gennan program,	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se			
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory	mester): Specialisation Mechanical Engi	neering, Focus Tl	neoretical Mechanical
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 s	mester): Specialisation Mechanical Engi	neering, Focus Tl	neoretical Mechanical
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Eng	neering, Focus Ti	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 s	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Eng	neering, Focus Ti	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7	mester): Specialisation Mechanical Engi emester): Specialisation Mechanical Eng semester): Specialisation Mechanical	neering, Focus Ti	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Enginemester): Specialisation Enginemester): Specialisation Enginemester): Specialisation Enginemester Engin	neering, Focus Ti	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Bioprocess Engineering: Core Qualification: Compulsory	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Sory hematics: Elective Compulsory	neering, Focus Ti	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Bioprocess Engineering: Core Qualification: Compulsor Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor Energy and Environmental Engineering: Core Qualific	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Sory hematics: Elective Compulsory y ation: Compulsory	neering, Focus Ti ineering, Focus I Engineering, Foo	neoretical Mechanical Product Development
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Bioprocess Engineering: Core Qualification: Compulsor Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor Energy and Environmental Engineering: Core Qualific General Engineering Science (English program, 7 ser	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginement Enginement Enginement Specialisation Mechanical Enginement Enginemen	neering, Focus Ti ineering, Focus I Engineering, Foc e:: Compulsory	neoretical Mechanical Product Development rus Energy Systems:
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Bioprocess Engineering: Core Qualification: Compulsor Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor Energy and Environmental Engineering: Core Qualific	mester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginemester): Specialisation Mechanical Enginement Enginement Enginement Specialisation Mechanical Enginement Enginemen	neering, Focus Ti ineering, Focus I Engineering, Foc e:: Compulsory	neoretical Mechanical Product Development rus Energy Systems:

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	co Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	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 design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools
	Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1280: MED I	II: Introduction to Physiology			
Courses				
Title	Typ Hrs/wk CP			
Introduction to Physiology (L0385)	Lecture 2 3			
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students can			
	describe the basics of the energy metabolism;			
	 describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology. 			
	,,,,,			
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing of information, developme			
	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				
Examination				
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic			
	Compulsory			
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			
	recinomaticinates. Specialisation in Engineering Science, Elective Compusory			

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

Module M1332: BIO I:	Experimental Methods in Biomechanics			
Courses	Courses			
Title Experimental Methods in Biomecha	Typ Hrs/wk CP anics (L0377) Lecture 2 3			
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
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 techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements, and choose the adequate techniques to the students can describe different measurement techniques for forces and movements.				
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.			
Personal Competence				
Social Competence	The students can, in groups, solve basic experimental tasks.			
Autonomy	The students can, in groups, solve basic experimental tasks.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics			
Following Curricula	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

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

Module M0829: Foun	dations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882)		Recitation Section (large)	2	3
Introduction to Management (L088		Lecture	3	3
Module Responsible	·			
Admission Requirements Recommended Previous				
Knowledge	j j			
Educational Objectives		d the following learning results		
Professional Competence	,			
Knowledge	After taking this module, students know the importa and Organisation to Marketing and Innovation, and a			
	explain the differences between Economics important definitions from the field of Manage explain the most important aspects of and g projects describe and explain basic business functions organization and human ressource managem. explain the relevance of planning and decuncertainty, and explain some basic methods state basics from accounting and costing and	ement oals in Management and name the most ons as production, procurement and so ent, information management, innovation ision making in Business, esp. in situal from mathematical Finance	important aspe ourcing, supply management ar	ects of entreprneuria chain management nd marketing
Skills	Students are able to analyse business units with resout an Entrepreneurship project in a team. In particu		jectives, strateg	ies etc.) and to carr
	analyse Management goals and structure there analyse organisational and staff structures of apply methods for decision making under mul analyse production and procurement systems analyse and apply basic methods of marketine select and apply basic methods from mathem apply basic methods from accounting, costing	companies tiple objectives, under uncertainty and ur and Business information systems g atical finance to predefined problems	der risk	
Personal Competence				
Social Competence	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 students.	, , , , ,	herent report or	n the project
Autonomy	Students are able to			
	 work in a team and to organize the team then to write a report on their project. 	nselves		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and	several written exams during the semester			
scale				
-	General Engineering Science (German program, 7 se			у
Following Curricula	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	· ·		orv
	General Engineering Science (German program, 7 se			51 y
	General Engineering Science (German program, 7 se	•		
	General Engineering Science (German program, 7 se	emester): Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se		_	
	General Engineering Science (German program,	/ semester): Specialisation Mechanica	Engineering,	Focus Mechatronic
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, F	Focus Biomechanic
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical I	Engineering, Foo	cus Aircraft System
	Engineering: Compulsory General Engineering Science (German program,			•
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 se Engineering: Compulsory	emester): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechanic
	General Engineering Science (German program, 7 s and Production: Compulsory	emester): Specialisation Mechanical Engi	neering, Focus F	Product Developme
	General Engineering Science (German program, 7	semester): Specialisation Mechanical E	ingineering, Foo	us Energy System

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload	Independent Study Time 62, Study Time in Lecture 28		

in Hours

Lecturer

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek DE

Language

WiSe/SoSe Cvcle

Course L0882: Management Tutorial

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 business idea from the point of view of an established company or a startup. knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction to Management		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneli	
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content		
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.	

Focus 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 M0730: Comp	outer Engineering			
Courses				
Title Computer Engineering (L0321) Computer Engineering (L0324)		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge	The successful completion of the labs will be honored du rules:	ring the evaluation of the module's e	examination acco	rding to the followin
	Upon a passed module examination, the student such that the examination's marks are lifted by 0, The improvement of the grade 5,0 up to 4,3 and compared to the student student such that the student such that the	3 or 0,4, respectively, up to the next		o the successful lab
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
	This module deals with the foundations of the function programming down to gates. The module includes the form of the introduction • Introduction • Combinational logic: Gates, Boolean algebra, Bool • Sequential logic: Flip-flops, automata, systematic • Technological foundations • Computer arithmetic: Integer addition, subtraction • Basics of computer architecture: Programming moderates • Memories: Memory hierarchies, SRAM, DRAM, cac • Input/output: I/O from the perspective of the CPU, The students perceive computer systems from the architecture composition of computer systems. The students can anacollection of few and simple components. They are able today's computing systems - from gates and circuits up to	ean functions, hardware synthesis, chardware design a, multiplication and division odels, MIPS single-cycle architecture, hes principles of passing data, point-to-passing the sect's perspective, i.e., they identify lyze, how highly specific and individe to distinguish between and to explanations.	ombinational net pipelining point connections the internal struc ual computers ca	works , busses ture and the physica n be built based on
	After successful completion of the module, the student system and the software executed on it. In particular, the on the hardware-centric abstraction layers from the asset the impact that these low abstraction levels have on an	ney shall understand the consequence embly language down to gates. This	ces that the exec way, they will be	ution of software had enabled to evaluat
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a	group and to present the results acc	cordingly.	
Autonomy	Students are able to acquire new knowledge from specif	ic 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			
Examination	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the		. ,		
Following Curricula	General Engineering Science (German program, 7 semestance)	ster): Specialisation Bioprocess Engin ster): Specialisation Naval Architectur ster): Specialisation Civil Engineering ster): Specialisation Electrical Engine ster): Specialisation Biomedical Engine ster): Specialisation Energy and Envir	eering: Compulsory re: Compulsory : Compulsory ering: Compulsor neering: Compulsor	y ory
	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 s			Focus Mechatron

Compulsory

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

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

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

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

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

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

Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

General Engineering Science (English program): Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0672: Signa	ls and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432)		Lecture Recitation Section (small)	3	4 2
Signals and Systems (L0433) Module Responsible	Drof Corbord Pouch	Recitation Section (Small)	2	2
Admission Requirements				
Recommended Previous				
Knowledge				
	The modul is an introduction to the theory of signals an	•	-	
	1-3 is expected. Further experience with spectral transbut not required.	sformations (Fourier Series, Fourier tra	instorm, Lapiace	transform) is user
	but not required.			
Educational Objectives	After taking part successfully, students have reached th	ne following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals a			
	theory. They are able to apply the fundamental transfo			
	can describe and analyse deterministic signals and sy understand the effects in time domain and image do			
	discrete-time signal.	main which are caused by the transit	ion or a contine	lous-time signar to
Skills	The students are able to describe and analyse determine	nistic signals and linear time-invariant	systems using n	nethods of signal ar
	system theory. They can analyse and design basic			
	response, stability, linearity etc They can assess the ir	mpact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant informati		-	ontrol their level
	knowledge during the lecture period by solving tutorial		m.	
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Written exam			
Examination duration and scale	90 min			
Assignment for the	General Engineering Science (German program): Specia	plication Floatrical Engineering, Compu	lcon	
Following Curricula	General Engineering Science (German program): Special General Engineering Science (German program): Special			
r onowing curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia	alisation Civil- and Enviromental Engen	eering: Compuls	ory
	General Engineering Science (German program): Specia	alisation Mechanical Engineering: Com	oulsory	
	General Engineering Science (German program): Specia			
	General Engineering Science (German program, 7 seme			У
	General Engineering Science (German program, 7 seme	·		
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme			NT/
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7			-
	Compulsory			
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical E	Engineering, Foo	us Energy System
	Compulsory			
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical I	Engineering, Foo	cus Aircraft System
	Engineering: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory General Engineering Science (German program, 7	comester): Specialisation Mechanica	l Engineering	Focus Mechatronic
	Compulsory	semester). Specialisation Mechanica	Lingineering,	rocus mechanome
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical Engir	eering, Focus Th	neoretical Mechanic
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Special	lisation Civil- and Enviromental Engene	eering: Compulso	ry
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special		-	
	General Engineering Science (English program): Special General Engineering Science (English program): Special			
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special			
	General Engineering Science (English program, 7 semes		-	
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes	ster): Specialisation Process Engineerir	ng: Compulsory	
	General Engineering Science (English program, 7 semes	ster): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanical	Engineering, F	ocus Biomechanic
	Compulsory General Engineering Science (English program, 7 se	amostor). Specialisation Manharity	inginocrine F	us Enorgy System
	General Engineering Science (English program, 7 se	mester). Specialisation Mechanical E	ingineering, Foc	us Ellergy System

Compulsory	ı
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems	i
Engineering: Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	i
Sciences: Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:	i
Compulsory	i
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	i
Engineering: Compulsory	i
Computational Science and Engineering: Core Qualification: Compulsory	i
Computational Science and Engineering: Core Qualification: Compulsory	i
Mechatronics: Core Qualification: Compulsory	i
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

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

Module M0684: Heat	Transfer			
Courses				
Title Heat Transfer (L0458) Heat Transfer (L0459)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Dr. Andreas Moschallski	-		
Admission Requirements	None			
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfe	r,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way	′ .		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develo	p an approach.		
Autonomy	The students are able to develop a complex problem self-co	onsistent and analyse the results i	n a critical way. A	qualified exchange
	with other students is given.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical I	Engineering, Focu	us Energy Systems:
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engin	eering: Compulso	ry
	General Engineering Science (German program, 7 semester	r): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanical
	Engineering: Elective Compulsory	idiosi Flostivo Compulsory		
	Energy Systems: Technical Complementary Course Core Stu General Engineering Science (English program, 7 semes	, ,	- - - - - - - - - - - - - - - - - - -	ıs Energy Systems
	Compulsory	.,	J2g, . 000	
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engine	ering: Compulsor	у
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engir	eering, Focus The	eoretical Mechanical
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation Energy Systems: Co Mechanical Engineering: Specialisation Theoretical Mechani		orv	
	Prechanical Engineering. Specialisation Theoretical Mechani	car Engineering, Elective Compuls	OI y	

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

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

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP
Introduction to Control Systems (LC Introduction to Control Systems (LC	
Module Responsible	
Admission Requirements	
-	Representation of signals and systems in time and frequency domain, Laplace transform
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain propertie first and second order systems
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response.
	root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	
	Students can transform models of linear dynamic systems from time to frequency domain and vice versa
	They can simulate and assess the behavior of systems and control loops They can simulate and assess the behavior of systems and control loops.
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can easily a part surely spiral approach be help of real loans with the help of real loans and frequency response to the real spirals.
	 They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for dig
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and us when solving given problems.
	when solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	<u> </u>
Credit points	<u> </u>
Credit points	6 Written exam
Credit points Examination	6 Written exam 120 min
Credit points Examination Examination duration and scale	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: 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 Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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 Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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 Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mec
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Bioprocess Engineering Science (German program, 7 semester): Specialisation Mechanical Engin
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

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
	Prof. Herbert Werner
Language	
Cycle	
Content	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	Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0597: Adva	nced Mechanical Engineering Design			
Courses				
Title Advanced Mechanical Engineering	Decian II (10264)	Typ Lecture	Hrs/wk	CP 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	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence	After passing the module students are able to			
Knowieuge	After passing the module, students are able to:			
	 explain complex working principles and functions of 	machine elements and of basic ele	ments of fluidics,	
	 explain requirements, selection criteria, application 		f complex machir	ne elements,
	 indicate the background of dimensioning calculation 	ns.		
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered management of a large state of a large		da 1.:!!!-\	
	 transfer knowledge learned in the module to new re recognize the content of technical drawings and sch 		ring skills),	
	evaluate complex designs, technically.	lematic sketches,		
	evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss technical information in	the lecture supported by activating	a methods.	
	Stadents are able to disease teeninear information in	tine lectare supported by delivating	y memodo.	
Autonomy	Students are able to independently deepen their ac	quired knowledge in exercises		
	Students are able to acquire additional knowledge		ood content e.a.	. bv using the video
	recordings of the lectures.		J	, ,
Workload in Hours				
Credit points	6			
Credit points Examination	6 Written exam			
Credit points Examination Examination duration and	6 Written exam			
Credit points Examination Examination duration and scale	6 Written exam 120	ester): Specialisation Mechanical F	-naineerina Foc	us Aircraft Systems
Credit points Examination Examination duration and scale Assignment for the	6 Written exam	ester): Specialisation Mechanical E	Engineering, Foc	us Aircraft Systems
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 General Engineering Science (German program, 7 sem			
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 General Engineering Science (German program, 7 sem Engineering: Compulsory			
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 General Engineering Science (German program, 7 sem Engineering: Compulsory General Engineering Science (German program, 7 sem	emester): Specialisation Mechanica	al Engineering,	Focus Materials in
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 General Engineering Science (German program, 7 sem Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory	emester): Specialisation Mechanica	al Engineering,	Focus Materials in
Credit points Examination Examination duration and scale Assignment for the	General Engineering Science (German program, 7 sem Engineering: Compulsory General Engineering Science (German program, 7 sem Engineering Sciences: Compulsory General Engineering Science (German program, 7 sem Compulsory General Engineering Science (German program, 7 sem Compulsory General Engineering Science (German program, 7 semestress)	emester): Specialisation Mechanical	al Engineering,	Focus Materials in focus Mechatronics:
Credit points Examination Examination duration and scale Assignment for the	General Engineering Science (German program, 7 sem Engineering: Compulsory General Engineering Science (German program, 7 sem Engineering Sciences: Compulsory General Engineering Science (German program, 7 sem Compulsory General Engineering Science (German program, 7 sem Compulsory General Engineering Science (German program, 7 sem Engineering Science) General Engineering Science (German program, 7 sem Engineering Science)	emester): Specialisation Mechanical mester): Specialisation Mechanical ter): Specialisation Mechanical Engi	al Engineering, I Engineering, F	Focus Materials in Focus Mechatronics:
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Course L0264: Advanced Med	chanical Engineering Design II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Seeigh 1 & 11
	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 bearingsAxes & 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.
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	Sowie weitere Bücher zu speziellen Themen

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

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

Course L0263: Advanced Mechanical Engineering Design I	
Typ Re	Recitation Section (large)
Hrs/wk 2	
CP 1	
Workload in Hours Inc	ndependent Study Time 2, Study Time in Lecture 28
Lecturer Pro	Prof. Dieter Krause, Prof. Otto von Estorff
Language DE	DE
Cycle Wi	ViSe
Content Se	See interlocking course
Literature Se	See interlocking course

Module M0655: Comp	utational Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (LC		Lecture	2	3
Computational Fluid Dynamics I (LC	0419)	Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Mathematical Methods for Engineers			
Knowledge	Fundamentals of Differential/integral calculus and ser	ies expansions		
	- Tundamentals of Emerchaldymograficated and Ser	ies expansions		
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial dif	ferential equations.		
Skills	The students are able develop appropriate numerical integra		overning partial dif	ferential equations.
	They can code computational algorithms in a structured way	<i>1</i> .		
Personal Competence				
Social Competence	The students can arrive at work results in groups and docum	nent them.		
Autonomy	The students can independently analyse approaches to solvi	ing specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7 semester)	: Specialisation Naval Architectu	ire: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical	Engineering, Focu	s Energy Systems:
	Elective Compulsory			-
	Energy Systems: Technical Complementary Course Core Stu	dies: Elective Compulsory		
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semest	ter): Specialisation Mechanical	Engineering, Focu	s Energy Systems:
	Elective Compulsory			
	Mechanical Engineering: Specialisation Energy Systems: Elec	ctive Compulsory		
	Naval Architecture: Core Qualification: Compulsory	Floriting Community		
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

	al Fluid Dynamics I
Тур	Lecture
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	Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms. 1. Partial differential equations 2. Foundations of finite numerical approximations 3. Computation of potential flows 4. Introduction of finite-differences 5. Approximation of convective, diffusive and transient transport processes 6. Formulation of boundary conditions and initial conditions 7. Assembly and solution of algebraic equation systems 8. Facets of weighted -residual approaches 9. Finite volume methods 10. Basics of grid generation
Literature	Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer

Course L0419: Computational Fluid Dynamics I	
Тур	Recitation Section (large)
Hrs/wk	2
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

Module M1022: Recip	rocating Machinery			
Courses				
	ines and Turbomachinery - Part Reciprocating Engines (L0633)	Typ Lecture	Hrs/wk	CP 1
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0634)		Recitation Section (large)	1 2	1 2
Internal Combustion Engines I (L0059) Internal Combustion Engines I (L0639)		Lecture Recitation Section (large)	2 1	2
	Prof. Christopher Friedrich Wirz	Recitation Section (large)	1	2
Admission Requirements	None			
Recommended Previous	Thermodynamics, Mechanics, Machine Elements			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	As a result of the part module "Fundamentals of Reciprocating power and working machinery and describe the qualitative a multiple types of engines, compressors and pumps. They ar regarding the development of power density and efficiency emissions. The students are able to select specific types of machine and the part module "Internal Combustion Enging regarding efficiency limits. In addition, they are able to characteristics and the approach of similarity. They are able to Detailed knowledge is present regarding computer-aided process."	nd quantitative correlations of or e able to utilize technical terms r, furthermore to give an overvi achinery and assess design relate es I", the students are able rel utilize their knowledge of desig to explain, assess and develop e	perating method and parameter iew of charging ed and operation flect and utilized n, mechanical	ds and efficiencies of rs as well as aspects g systems, fuels and nal problems. e the state-of-the-art and thermodynamic
Skills	The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design.			
Personal Competence				
_	The students are able to communicate and cooperate in application.	a professional environment in	the field of ma	achinery design and
Autonomy	The widespread scope of gained knowledge enables the stude confidently.	ents to handle situations in their	future professio	on independently and
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				_
Assignment for the	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical E	ngineering, Foo	cus Energy Systems:
Following Curricula	Compulsory			
	Energy Systems: Technical Complementary Course Core Studi General Engineering Science (English program, 7 semeste Compulsory	r): Specialisation Mechanical En	ngineering, Foc	us Energy Systems:
	Mechanical Engineering: Specialisation Energy Systems: Com	puisory		

Course L0633: Fundamentals	s of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Christopher Friedrich Wirz
Language	DE
Cycle	WiSe
Content	Verbrennungsmotoren Historischer Rückblick Einteilung der Verbrennungsmotoren Arbeitsverfahren Vergleichsprozesse Arbeit, Mitteldrücke, Leistungen Arbeitsprozess des wirklichen Motors Wirkungsgrade Gemischbildung und Verbrennung Motorkennfeld und Betriebskennlinien Abgasentgiftung Gaswechsel Aufladung Kühl- und Schmiersystem Kräfte im Triebwerk Kolbenverdichter Thermodynamik des Kolbenverdichters Einteilung und Verwendung Kolbenpumpen Prinzip der Kolbenpumpen
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	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0059: Internal Comb	oustion Engines I
Тур	Lecture
Hrs/wk	2
СР	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	Course L0639: Internal Combustion Engines I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Thiemann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0639: Gas a	nd Steam Power Plants			
Courses				
Title		Тур	Hrs/wk	СР
Gas and Steam Power Plants (L020		Lecture	3	5
Gas and Steam Power Plants (L021)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements Recommended Previous	None			
Knowledge	"Technical Thermodynamics I and II"			
	"Heat Transfer" "Fluid Mechanics"			
	After taking part successfully, students have reached the	following learning results		
Professional Competence	The students can evaluate the development of the ele-	ctricity demand and the energy con	version routes in	the thermal nower
	plant, describe the various types of power plant and the operation characteristics of the power plant. Addition combination possibilities of conventional fossil-fuelled pequipped with Carbon Capture and Storage. The students have basic knowledge about the principles,	layout of the steam generator block nally they can describe the exhau power plants with solar thermal and	. They are also a st gas cleaning d geothermal po	ble to determine the apparatus and the
	The stadents have saste knowledge about the principles,	operation and design or tarbornacis.	,	
Skills	The students will be able, using theories and methods knowledge on the function and construction of gas and s and electricity, so as to develop conceptual solutions. between heat and power generation the students are e concepts for the generation of electricity and the product follow better the deliberations on the electricity mix contents are environmental protection).	team power plants, to identify basic Through analysis of the problem an ndowed with the capability and met tion of heat. From the technical basi	associations in the dexposure to the hodology to devenue the students by	ne production of heat ne inherent interplay elop realistic optimal necome the ability to
	Within the framework of the exercise the students learn tool small practical tasks are solved with the PC, to highli			
	The students are able to do simplified calculations on to level.	urbomachinery either as part of a pl	ant, as single co	mponent or at stage
Personal Competence				
Social Competence	An excursion within the framework of the lecture is plant			
	contact with a modern power plant in this region. The s and gain insights into the conflicts between technical and	·	ence with a pow	er plant in operation
Autonomy	The students assisted by the tutors will be able to develor this manner the theoretical and practical knowledge for process combinations and boundary conditions highlig performance of steam power plants and calculate selected.	p alone simple simulation models an rom the lecture is consolidated and hted. The students are able indep	the potential e endently to ana	ffects from different
	Independent Study Time 124, Study Time in Lecture 56			
Credit points Examination	6 Writton over			
scale	The committee of 120 mm			
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Energy and Enviro	omental Enginee	ring: Compulsory
Following Curricula		mester): Specialisation Mechanical I	Engineering, Foc	us Energy Systems:
	Elective Compulsory	tonic Consciolistics For	amankel For	dans Constitution
	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 ser		3	, ,
	Elective Compulsory	nester). Specialisation Mechanical i	ingineering, roc	us Ellergy Systems.
	Energy and Environmental Engineering: Core Qualificatio	n: Compulsory		
	Energy and Environmental Engineering: Core Qualificatio	n: Compulsory		
	Energy Systems: Technical Complementary Course Core	• •		
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 sen Elective Compulsory		-	
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 sen Elective Compulsory		-	
	Mechanical Engineering: Specialisation Energy Systems: Mechanical Engineering: Specialisation Energy Systems:			
l	3 3	111111111111111111111111111111111111111		

Course L0206: Gas and Stear	n Power Plants
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
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 Layout of the power plant Layout 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

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 a tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The studer 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	Course L0210: Gas and Steam	m Power Plants
Herwik 1 CP 1 Workload in Mours Lacturer Prof. Alfons Kather Language 10 Cycle Wise Content in the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including: - Energy behance of a fluid-flow machine - Theory of turbine and compressor stage - Equal and positive pressure blading - Flow losses - Characteristic numbers - Axial and radial designs - Design examples of reciprocating engines and turbomachinery - State mypower plants - Design examples of reciprocating engines and turbomachinery - State mypower plants - Cast turbine systems - Design examples of reciprocating engines and turbomachinery - State mypower plants - Cast turbine systems - Design examples of reciprocating engines and turbomachinery - State mypower plants - Cast turbine systems - Design examples of reciprocating engines and furbomachinery - State mypower plants - Cast turbine systems - Design examples of reciprocating engines and furbomachinery - State mypower plants - Cast turbine systems - Design examples of reciprocating engines and furbomachinery - State power plants - Cast turbine systems - Design examples of reciprocating engines and furbomachinery - State power plant source - Design examples of reciprocating engines and turbomachinery - State power plant source - Design examples of reciprocating engines and turbomachinery - State power plant block - Individual elements of the power plants - Energy Conversion in Thermal Power Plants - Layout of the power plant block - Individual elements of the power plant - Cooling systems - New gas cleaning - Operation characteristics of the power plant - Cooling systems - New gas cleaning - Operation characteristics of the power plant - Cooling systems - New gas cleaning - Operation characteristics of the power plant operation from interconnecting conventional power plants - Cooling systems - New gas cleaning - Operation characteristics of the power plant operation from interconnecting conventional power plants - Cooling systems - Liter	Tyn	Recitation Section (Jame)
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Lecture Prof. Affons Kather		
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Equal and positive pressure blading Flow losses Characteristic numbers Axial and radial design Design features Hydraulic fluid-flow machines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems Dissel engine systems Dissel engine systems Electricity Demand and Forecasting Thormodynamic 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 Cooling systems Flue gas cleaning Operation characteristics of the power plant Cooling systems Flue gas cleaning Operation characteristics of the power plant Cooling systems Flue gas cleaning Operation characteristics 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 are newable energy sources are discussed and the betwincial options for providing security of supply and network stability of 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, Within tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The student present their results orally and can afterwards ask questions and get feedback. The course work has		Energy balance of a fluid-flow machine
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	dations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882)		Recitation Section (large)	2	3
Introduction to Management (L0880		Lecture	3	3
Module Responsible	·			
•	None Paris Knowledge of Mathematics and Business			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence	The taking part succession, frequency have reached a	ic ronowing rearring results		
•	After taking this module, students know the important and Organisation to Marketing and Innovation, and also			
	 explain the differences between Economics a important definitions from the field of Manageme explain the most important aspects of and goal projects describe and explain basic business functions organization and human ressource management explain the relevance of planning and decisic uncertainty, and explain some basic methods fro state basics from accounting and costing and sel 	ent s in Management and name the most as production, procurement and so , information management, innovation n making in Business, esp. in situa m mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneuri chain managemer nd marketing
Skills	Students are able to analyse business units with respe- out an Entrepreneurship project in a team. In particular		jectives, strateg	ies etc.) and to car
	analyse Management goals and structure them a analyse organisational and staff structures of cor apply methods for decision making under multip analyse production and procurement systems an analyse and apply basic methods of marketing select and apply basic methods from mathematic apply basic methods from accounting, costing are	mpanies le objectives, under uncertainty and ur d Business information systems cal finance to predefined problems	nder risk	
Personal Competence	Students are able to			
	work successfully in a team of students to apply their knowledge from the lecture to an e to communicate appropriately and to cooperate respectfully with their fellow studer Students are able to work in a team and to organize the team themse to write a report on their project.	ts.	pherent report or	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
•	Subject theoretical and practical work			
	several written exams during the semester			
scale	<u> </u>			
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Electrical Enginee	ring: Compulsor	/
Following Curricula	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme	ester): Specialisation Biomedical Enginester): Specialisation Naval Architecturester): Specialisation Computer Science	eering: Compulsory e: Compulsory e: Compulsory	
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 Compulsory	ester): Specialisation Civil Engineering: ester): Specialisation Energy and Enviro	Compulsory omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sc	•		
	Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 semi			
	Engineering: Compulsory General Engineering Science (German program, 7 sem and Production: Compulsory General Engineering Science (German program, 7 sem	-	-	·

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

WiSe/SoSe Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Module M0618: Rene	wables and Energy Systems			
Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Indust	ry (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)	In case 11 10 11 11	Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements				
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have reach	and the following learning results		
Professional Competence	After taking part successiony, students have react	led the following learning results		
Knowledge	With completion of this module, the students car	nrovide an overview of characteristics	of anargy systems	and their economic
Knowiedge	efficiency. They can explain the issues occurring in			
	distribution and power trading wih regard to s			
	applicable to many energy systems in general, e			
	the students can explain the environmental benef			
Skille	Students are able to apply methodologies for detail	ailed determination of energy demand or	energy production	for various types of
Skills	energy systems. Furthermore, they can evaluate			
	under certain given conditions. Therefore, the			
	standardized solutions of a problem.	,		
	The students are able to explain questions and p	ossible approaches to its processing from	the field of renev	wable energies orally
	and to put them them into the right context.			
Personal Competence				
Social Competence	The students are able to analyze suitable techni	ical alternatives and to assess them with	technical, econo	mical and ecological
	criteria under sustainability aspects. This allows th	em to make an effective contribuition to a	more sustainable	power supply.
Autonomy	Students can independently exploit sources , ac	guire the particular knowledge about the	subject area and	transform it to new
riacoriomy	questions.	quire the particular knowledge about the	subject area and	cransionin ic to new
Workload in Hours	, , , , , , , , , , , , , , , , , , , ,	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and	3 hours written exam			
scale				
	General Engineering Science (German program, 7			
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foo	us Energy Systems:
	Elective Compulsory	competent. Coosislies time December 5	wine. Flactice C	anulaan.
	General Engineering Science (German program, 7 Energy and Environmental Engineering: Core Qual		anny: Elective Con	ipui50i y
	General Engineering Science (English program, 7 s	• •	romental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 s		_	
	Elective Compulsory	, semester). Specialisation Mecilalical	Engineering, roc	as energy systems
	General Engineering Science (English program, 7 s	semester): Specialisation Process Engineer	ring: Elective Com	pulsory
	Process Engineering: Core Qualification: Compulso		5	
	5 5 1411 11 3511	-		

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

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

Course L0313: Renewable En	nergy
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/EN
Cycle	SoSe
Content	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

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

Focus Aircraft Systems Engineering

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

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

Courses					
litle .		Тур	Hrs/wk	СР	
dvanced Mechanical Engineering	Design II (L0264)	Lecture	2	2	
dvanced Mechanical Engineering	_	Recitation Section (large)	2	1	
dvanced Mechanical Engineering	_	Lecture	2	2	
dvanced Mechanical Engineering		Recitation Section (large)	2	1	
Module Responsible					
Admission Requirements					
Recommended Previous	 Fundamentals of Mechanical Engineering 	Design			
Knowledge	Mechanics				
	 Fundamentals of Materials Science 				
	Production Engineering				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results			
Professional Competence		defice the following learning results			
•	After passing the module, students are able to:				
7070 Medge	, meet passing the module, stadenes are asie to				
	explain complex working principles and form				
	explain requirements, selection criteria, a		es of complex mach	ine elements,	
	indicate the background of dimensioning	calculations.			
Skills	After passing the module, students are able to:				
		and the second s			
	accomplish dimensioning calculations of a transfer transfer transfer to the readulations.		aabiina akilla)		
	transfer knowledge learned in the module		solving skills),		
	recognize the content of technical drawin	igs and schematic sketches,			
	 evaluate complex designs, technically. 				
Personal Competence					
Social Competence	Chudanta are able to discuss to shaired inf	investion in the leature grouperted by estimate	sting weatherda		
	Students are able to discuss technical inf	ormation in the lecture supported by activa	iting methods.		
Autonomy	, Charleste and able to independently decre	and the single-service of the service describes a service of			
	Students are able to independently deeper Students are able to assure additional.		arctand contant a	a by using the vie	
	 Students are able to acquire additional recordings of the lectures. 	knowledge and to recapitulate poorly und	erstood content e.ç	g. by using the vic	
	recordings of the rectares.				
Workload in Hours	Independent Study Time 68, Study Time in Lect	ure 112			
Credit points					
Examination					
Examination duration and					
scale		Consideration Manhaginal Francescope F			
	General Engineering Science (German program)				
Following Curricula		m): Specialisation Mechanical Engineerin	g, Focus Aircraft S	systems Engineeri	
	Compulsory General Engineering Science (German program	A), Specialization Machanical Engineering	Focus Materials in F	Engineering Ecione	
	Compulsory	7). Specialisation Mechanical Engineering, 1	ocus Materiais III i	ingineering scienc	
	General Engineering Science (German program)). Specialisation Mechanical Engineering Fo	ocus Mechatronics:	Compulsory	
	General Engineering Science (German program)				
	Production: Compulsory		,,		
	General Engineering Science (German prod	gram): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechan	
	Engineering: Compulsory	5	3.		
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanic	al Engineering, Fo	cus Aircraft Syste	
	Engineering: Compulsory				
	General Engineering Science (German progr	ram, 7 semester): Specialisation Mecha	nical Engineering,	Focus Materials	
	Engineering Sciences: Compulsory				
	General Engineering Science (German progr	ram, 7 semester): Specialisation Mechar	nical Engineering,	Focus Mechatron	
	Compulsory				
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical E	ingineering, Focus	Product Developm	
	and Production: Compulsory				
	General Engineering Science (German program	, 7 semester): Specialisation Mechanical Er	ngineering, Focus T	heoretical Mechan	
	Engineering: Compulsory				
	General Engineering Science (German progra	am, / semester): Specialisation Mechan	ical Engineering,	Focus Biomechan	
	Compulsory	m 7 competent Constitution Mark	al Enginerator 5	nua Enaveri Ciril	
	Compulsory General Engineering Science (German progra Compulsory	m, 7 semester): Specialisation Mechanic	al Engineering, Foo	cus Energy Syster	

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

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

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

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

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

Course L0262: Advanced Med	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	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.
	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.
	Souis waiters Bücher zu spaziellen Theman
	Sowie weitere Bücher zu speziellen Themen

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

Module M0672: Signa	ils 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 and syst		-	
	1-3 is expected. Further experience with spectral transformation	ations (Fourier series, Fourier tra	insform, Laplace	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
•	The students are able to classify and describe signals and lir	near time-invariant (LTI) systems	using methods	of signal and system
i.i.o.ieage	theory. They are able to apply the fundamental transformati		-	-
	can describe and analyse deterministic signals and systems			
	understand the effects in time domain and image domain	•	-	
	discrete-time signal.	which are caused by the transit	ion or a continu	lous time signar to a
Skille	The students are able to describe and analyse deterministic	signals and linear time-invariant	evetame using r	nethods of signal and
Skills	system theory. They can analyse and design basic system			
	response, stability, linearity etc They can assess the impact			
Personal Competence		or Err systems on the signal proj	berties in time a	nd frequency domain.
•				
	The students can jointly solve specific problems.			
Autonomy	· ·		-	control their level of
	knowledge during the lecture period by solving tutorial proble	ems, software tools, clicker syste	m.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisation	on Electrical Engineering: Compu	Isory	
Following Curricula	General Engineering Science (German program): Specialisation	on Computer Science: Compulsor	У	
	General Engineering Science (German program): Specialisation	on Process Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	on Bioprocess Engineering: Comp	oulsory	
	General Engineering Science (German program): Specialisation	on Civil- and Enviromental Engen	eering: Compuls	ory
	General Engineering Science (German program): Specialisation	on Mechanical Engineering: Com	oulsory	
	General Engineering Science (German program): Specialisation	on Biomedical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Electrical Enginee	ring: Compulsor	у
	General Engineering Science (German program, 7 semester):	Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engine	eering: Compuls	ory
	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engine	eering: Compuls	ory
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineering,	Focus Biomechanics:
	Compulsory			
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical E	Engineering, Foo	cus Energy Systems:
	Compulsory			
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical I	Engineering, Fo	cus Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semester)	Specialisation Mechanical Engir	eering, Focus T	neoretical Mechanical
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisatio	n Civil- and Enviromental Engene	eering: Compuls	ory
	General Engineering Science (English program): Specialisatio	n Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Electrical Engineering: Compul	sory	
	General Engineering Science (English program): Specialisatio			
	General Engineering Science (English program): Specialisatio	n Mechanical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Biomedical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Process Engineering: Compulso	ory	
	General Engineering Science (English program, 7 semester):	Specialisation Electrical Engineer	ing: Compulsory	,
	General Engineering Science (English program, 7 semester):	Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering	ng: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical	Engineering,	ocus Biomechanics:
	Compulsory			
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical E	Engineering, Foo	us Energy Systems:
	·			

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Module M0596: Adva	nced Mechanical Design Project
Courses	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Proje	ct (L0266) Project-/problem-based Learning 4 6
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to:
	express the procedure for systematically handling of
	complex design tasks ,
	describe working principles, their use and combination possibilities,
	explain guidelines for designing for function and manufacturing,
	explain advanced use-oriented knowledge of machine elements.
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 colutions and technical drawings within groups
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course
	Fellect the own results in the work groups of the course
Autonomy	After passing the module, students are able to:
	independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting
	appropriate methods,
	to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and	180
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Following Curricula	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica
	Engineering: Compulsory
	Mechanical Engineering: Core Qualification: Compulsory

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

Module M1320: Simul	ation and Design of Mechatronic Systems				
Courses					
Title Simulation and Design of Mechatronic Systems (L1822) Simulation and Design of Mechatronic Systems (L1823)		Typ Lecture Recitation Section (large)	Hrs/wk 2 1	CP 2 2	
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2	
Module Responsible	Prof. Uwe Weltin				
Admission Requirements	None				
Recommended Previous	Fundatmentals of mechanics, control theory and electrical eng	jineering			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence					
Knowledge	Students are able to describe methods and calculations for de	sign, modeling, simulation and	optimization of n	nechatronic systems.	
Skills	Students are able to apply modern algorithms for modeling of systems and implement those in laboratory conditions.	mechatronic systems. They ca	n identify, simula	ite and design simple	
Personal Competence					
Social Competence	Students are able to work goal-oriented in small mixed groups	and present results to target of	roups.		
Autonomy	Students are able to recognize and improve knowledge deficit	s independently.			
	With instructor assistance, students are able to evaluate their	own knowledge level and defin	e a further cours	e of study.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanica	al Engineering,	Focus Mechatronics:	
Following Curricula					
	General Engineering Science (German program, 7 semeste Engineering: Compulsory	r): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systems	
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechanical	
	Engineering: Elective Compulsory				
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanica	al Engineering,	Focus Mechatronics:	
	Compulsory	-\ Ci-liti Mbil	Fundamentary For	Aircraft Contains	
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systems	
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory				
	Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory				
	Mechanical Engineering: Specialisation Mechatronics: Compuls				
	Mechanical Engineering: Specialisation Theoretical Mechanica	Engineering: Compulsory			
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory				
	Mechatronics: Core Qualification: Compulsory				

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

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

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

Module M0833: Intro	duction to Control Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Systems (Li	0654)	Lecture	2	4
Introduction to Control Systems (Li		Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time an	d frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge				
	Students can represent dynamic system b	ehavior in time and frequency domain, and o	can in particular	explain properties of
	first and second order systems	entral loops and interpret dynamic propertie	s in tarms of frac	woney rosponso and
	 They can explain the dynamics of simple c root locus 	ontrol loops and interpret dynamic propertie	s iii teriiis or irec	quericy response and
	They can explain the Nyquist stability crite	rion and the stability margins derived from it		
	They can explain the role of the phase mar			
	They can explain the way a PID controller a			
	They can explain issues arising when contr	ollers designed in continuous time domain a	re implemented	digitally
Skills				
SKIIIS	Students can transform models of linear dy	namic systems from time to frequency doma	ain and vice vers	a
	They can simulate and assess the behavior	of systems and control loops		
	They can design PID controllers with the he			
	They can analyze and synthesize simple co			
	They can calculate discrete-time appro- implementation	kimations of controllers designed in conf	inuous-time and	d use it for digital
	implementationThey can use standard software tools (Mat	ah Control Toolboy Simulink) for carrying o	it these tasks	
	They can use standard software tools (Mac	ab Control Toolbox, Simulink, for carrying of	it these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve	technical problems, and experimentally vali	date their contro	ller designs
Autonomy	· ·	sources (lecture notes, software documenta	ation, experimen	t guides) and use it
	when solving given problems.			
	They can assess their knowledge in weekly on-lin	e tests and thereby control their learning pro	gress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecti	ire 56		
Credit points				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Computer Science	e: Compulsory	
Assignment for the Following Curricula		·		ory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture	eering: Compulso e: Compulsory	ory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering:	eering: Compulso e: Compulsory Compulsory	
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	to 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 D. C. Burfand B. H. Bishan, "Modern Control Systems", Addison Works, Boother, MA 2010.
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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

Caurage	
Courses	To Harlest CD
Title Computer Engineering (L0321)	Typ Hrs/wk CP Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	Prof. Heiko Falk
Admission Requirements	None
Recommended Previous	Basic knowledge in electrical engineering
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	P This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-le programming down to gates. The module includes the following topics:
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses
Ckillo	
ЗКШЗ	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the phys composition of computer systems. The students can analyze, how highly specific and individual computers can be built based o 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 compusystem and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence	
	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Autonomy	stadents are able to dequire new knowledge from specific increases and to associate and knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
	Written exam
Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0599: Integ	rated Product Development and Lightweig	ht Design		
Courses				
Title CAE-Team Project (L0271) Development of Lightweight Design		Typ Project-/problem-based Learning Lecture	Hrs/wk 2 2	CP 2 2
Integrated Product Development I (Lecture	2	2
	Prof. Dieter Krause			
Admission Requirements	None Advanced Knowledge about engineering design:			
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	After completing the module, students are capable of:			
	 explaining the functional principle of 3D-CAD-Systems, I describing the interaction of the different CAE-Systems 		SS .	
Skills				
SKIIIS	After completing the module, students are able to:			
	 evaluate different CAD- and PDM-Systems with regard product structuring design an exemplary product using CAD-,PDM- and/or FI 		ıch as classifi	cation schemes and
Personal Competence Social Competence	After completing the module, students are able to:			
	 To develop a project plan and allocate work appropriate Present project results as a team for instance in a prese 		of group discu	issions
Autonomy	Students are capable of:			
	independently adapt to a CAE-Tool and complete a give	n practical task with it		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Eng	ineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compulsory	r). Specialisation Machanical Eng	incoring Foc	us Aircraft Systems
	General Engineering Science (English program, 7 semester Engineering: Compulsory	,, specialisation Methanical Eng	meening, FOC	us Anciait systems
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compulsory		-	•
	Mechanical Engineering: Specialisation Product Development a	and Production: Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems Engine		Election C	
	Product Development, Materials and Production: Technical Cor	npiementary Course Core Studies:	Elective Comp	ouisory

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

Module M0767: Aeron	autical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Aircraft Systems (L0741)	Lecture	2	2
Fundamentals of Aircraft Systems (L0742)	Recitation Section (small)	1	1
Air Transportation Systems (L0591)		Lecture	2	2
Air Transportation Systems (L0816)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, mechanics and thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students get a basic understanding of the structure and	I design of an aircraft, as well as a	n overview of th	ne systems inside an
	aircraft. In addition, a basic knowledge of the relationchip	s. the kev parameters, roles and wa	vs of working in	different subsystems
	in the air transport is acquired.	.,	,	
Skills	Due to the learned cross-system thinking students can	gain a deeper understanding of	different system	concepts and their
	technical system implementation. In addition, they can ap		-	·
	the air transportation system in the context of the overall	• •	g., a a	ienie or odboysteinio or
Personal Competence	and an example called a system in the context of the overall	3,3.0		
	Students are made aware of interdisciplinary communicat	ion in groups.		
,	Students are able to independently analyze different sy	- ·	implementation	as well as to think
Autonomy	system oriented.	ystem concepts and their teermical	mplementation	do well do to tillik
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	, ,			
Examination				
Examination duration and				
scale	130 (((()))			
	Constal Engineering Coiones (Cornes avegues 7 com	actor). Considiration Machanial	Facinossina For	us Airereft Customs
_	General Engineering Science (German program, 7 sem	lester): Specialisation Mechanical	Engineering, Foc	us Aircrait Systems
Following Curricula	Engineering: Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical I	ingineering, Foo	tus Aircraft Systems
	Engineering: Compulsory			
	Logistics and Mobility: Specialisation Logistics and Mobility	• •		
	Mechanical Engineering: Specialisation Aircraft Systems E	ngineering: Compulsory		

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

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

Courses				
Fitle		Тур	Hrs/wk	СР
Management Tutorial (L0882) ntroduction to Management (L088	0)	Recitation Section (large) Lecture	2	3
Module Responsible			-	-
Admission Requirements	None			
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important be and Organisation to Marketing and Innovation, and also t			
	 explain the differences between Economics an important definitions from the field of Managemen explain the most important aspects of and goals projects describe and explain basic business functions organization and human ressource management, i explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and selection 	in Management and name the mos as production, procurement and s information management, innovation making in Business, esp. in situa mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain managemend d marketing
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular, t		ojectives, strateg	ies etc.) and to car
	 analyse Management goals and structure them ap analyse organisational and staff structures of com apply methods for decision making under multiple analyse production and procurement systems and analyse and apply basic methods of marketing select and apply basic methods from mathematica apply basic methods from accounting, costing and 	panies objectives, under uncertainty and un Business information systems I finance to predefined problems	nder risk	
Personal Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an en to communicate appropriately and to cooperate respectfully with their fellow students Students are able to work in a team and to organize the team themselv to write a report on their project.		oherent report or	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
•	Subject theoretical and practical work			
	several written exams during the semester			
scale				
	General Engineering Science (German program, 7 semes	er): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula	General Engineering Science (German program, 7 semes Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering Sciences: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory	cer): Specialisation Biomedical Engin cer): Specialisation Naval Architectur cer): Specialisation Computer Science cer): Specialisation Bioprocess Engin cer): Specialisation Civil Engineering: cer): Specialisation Energy and Envir cemester): Specialisation Mechanical	eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory omental Enginee al Engineering, I Engineering, Formal Engineering, Engineering, Formal Engineering, al Engineering,	ring: Compulsory Focus Mechatroni Ocus Biomechani us Aircraft Syster Focus Materials
	General Engineering Science (German program, 7 seme and Production: Compulsory General Engineering Science (German program, 7 ser			•

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

WiSe/SoSe Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Focus Materials in Engineering Sciences

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

Module M0597: Adva	nced Mechanical Engineering Desig	n		
Courses				
Title Advanced Mechanical Engineering		Typ Lecture	Hrs/wk	CP 2
Advanced Mechanical Engineering Advanced Mechanical Engineering	Design I (L0262)	Recitation Section (large) Lecture	2	1 2
Advanced Mechanical Engineering		Recitation Section (large)	2	1
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Des	sign		
	Mechanics Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully students have reache	nd the following learning results		
Professional Competence	After taking part successfully, students have reache	ed the following learning results		
	After passing the module, students are able to:			
	explain complex working principles and funct	ions of machine elements and of hasic ele	ments of fluidics	
	explain requirements, selection criteria, appli			
	indicate the background of dimensioning calc	culations.		
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of coverage.	ered machine elements		
	transfer knowledge learned in the module to		ving skills),	
	recognize the content of technical drawings a	and schematic sketches,		
	evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss technical inform	ation in the lecture supported by activatin	n methods	
		and the recease supported by delivation	g meanous.	
Autonomy	Students are able to independently deepen to	heir acquired knowledge in exercises.		
	Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video			
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture	112		
Credit points				
Examination Examination duration and	Written exam			
scale				
Assignment for the	General Engineering Science (German program): Sp	pecialisation Mechanical Engineering, Focus	s Energy System	s: Compulsory
Following Curricula	General Engineering Science (German program):	Specialisation Mechanical Engineering, I	ocus Aircraft S	ystems Engineering:
	Compulsory General Engineering Science (German program): S	necialisation Machanical Engineering Foc	ıc Matorials in F	naineerina Sciences
	Compulsory	pecialisation Mechanical Engineering, 10cl	us Materials III E	ngmeering sciences.
	General Engineering Science (German program): Sp	ecialisation Mechanical Engineering, Focus	s Mechatronics: (Compulsory
	General Engineering Science (German program)	: Specialisation Mechanical Engineering	, Focus Produc	t Development and
	Production: Compulsory General Engineering Science (German program	n): Specialisation Mechanical Engineer	ing, Focus The	oretical Mechanical
	Engineering: Compulsory		3.	
	General Engineering Science (German program,	7 semester): Specialisation Mechanical I	Engineering, Foo	us Aircraft Systems
	Engineering: Compulsory General Engineering Science (German program,	7 samester). Specialisation Mechanic	al Engineering	Focus Materials in
	Engineering Sciences: Compulsory	, / semestery. Specialisation Mechanic	ur Engineering,	rocus materiais ii
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, l	ocus Mechatronics:
	Compulsory	competer), Enocialization Machania - Francis	nooring Forus 5	Irodust Douglasses
	General Engineering Science (German program, 7 and Production: Compulsory	semester): Specialisation Mechanical Engl	neering, Focus F	roduct Development
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechanica
	Engineering: Compulsory			
		7 semester): Specialisation Mechanical	Engineering, F	ocus Diamochanics
	General Engineering Science (German program,	,,	3 3.	ocus biomechanics.
	General Engineering Science (German program, Compulsory General Engineering Science (German program,			
	Compulsory			
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical E	Engineering, Foc	us Energy Systems:

Compulsory

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

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

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

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

Course L0262: Advanced Me	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	• Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Auf Die Din-Normen; Klein, M., Teubner-Verlag. Auf Die Din-Normen; Klein, M., Teubner-Verlag. Auf Din-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Machine alexante 1.2. Chlocht B. Barran Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Carbeltone Branchenge About allege Ut behave the Badanatain - F. Carbena Walter - I behave the Badanatain - F. Carbena Walter -
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage
	Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	- Noton, reduce reasonmente entended, witter, in, reans, b., januasch, b., vobiek, j., springer vieweg, aktuelle Aulidge.
	Sowie weitere Bücher zu speziellen Themen

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

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				
Admission Requirements				
Recommended Previous Knowledge	Mathematics 1-3			
Kilowieuge	The modul is an introduction to the theory of signals and s	stems. Good knowledge in maths	as covered by th	e moduls Mathema
	1-3 is expected. Further experience with spectral transfor	mations (Fourier series, Fourier tr	ansform, Laplace	transform) is usef
	but not required.			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
•	The students are able to classify and describe signals and	linear time-invariant (LTI) systems	using methods	of signal and system
	theory. They are able to apply the fundamental transform			
	can describe and analyse deterministic signals and syste		-	-
	understand the effects in time domain and image domain	n which are caused by the transi	tion of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determinist	c signals and linear time-invariant	systems using m	nethods of signal ar
	system theory. They can analyse and design basic sys	tems regarding important proper	ties such as ma	agnitude and phas
	response, stability, linearity etc They can assess the impa	ct of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information			ontrol their level
	knowledge during the lecture period by solving tutorial pro	blems, software tools, clicker syste	em.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisa	tion Electrical Engineering: Compu	ılsory	
Following Curricula				
	General Engineering Science (German program): Specialisa			
	General Engineering Science (German program): Specialism			
	General Engineering Science (German program): Specialisa			ory
	General Engineering Science (German program): Specialisa General Engineering Science (German program): Specialisa			
	General Engineering Science (German program, 7 semeste			<i>y</i>
	General Engineering Science (German program, 7 semeste			y
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste			ory
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanica	l Engineering, F	ocus Biomechanic
	Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical	Engineering, Foo	us Energy System
	Compulsory			
	General Engineering Science (German program, 7 semi	ester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systen
	Engineering: Compulsory			_
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory	anakan). Can-i-liki-	d Fastered 1	Facus March 1
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanica	ıı Engineering,	rocus Mecnatronic
	Compulsory General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engir	neering Focus Th	neoretical Mechanic
	Engineering: Compulsory	,. opecianouton mechanical Eligii	.ccimy, rocus II	.corected mechallic
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisa	tion Civil- and Enviromental Engen	eering: Compulso	ry
	General Engineering Science (English program): Specialisa	tion Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisa	tion Electrical Engineering: Compul	sory	
	General Engineering Science (English program): Specialisa	tion Computer Science: Compulsor	у	
	General Engineering Science (English program): Specialisa	tion Mechanical Engineering: Comp	oulsory	
	General Engineering Science (English program): Specialisa	tion Biomedical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semester			
	General Engineering Science (English program, 7 semester			
	General Engineering Science (English program, 7 semester	· •		
	General Engineering Science (English program, 7 semester			-
	General Engineering Science (English program, 7 semester			
	General Engineering Science (English program, 7 sen	lester): Specialisation Mechanica	ı Engineering, F	ocus Biomechanic
	Compulsory General Engineering Science (English program 7 some	ctor). Enocialisation Machania !	Enginossina F	us Energy System
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical I	ingineering, Foc	us Energy System

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Module M0988: Structural Materials				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanical Prope	rties of Materials (L1090)	Lecture	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are res	ponsible for the mechanical behavio	ur of metals. They acqu	uire basic knowlegde
	in modelling of the materials behaviour. Furthermor	e, the students learn about the beh	aviour of metals under	static and dynamic
	loads. The students get to know the most importar	nt welding technologies and the cor	responding systems. T	hey learn about the
	influence of welding on the materials and design.			
Skille	The students know the mechanical properties of i	metals and the underlying principle	s They are able to n	ame the influencing
SKIIIS	factors on the welding behaviour of steel materials.	netals and the underlying principle	.s. They are able to the	anie the initiation
	Tactors on the melaning behaviour or steel materials.			
	The students are able to select between alloys acco	ording to the desired mechaincal pro	perties and welability.	They can distinguish
	between different welding techniques and select the	e suitable technique and system con	nponents for a defined	application. They are
	able to dimension weld joints within design tasks.			
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	2 70		
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Med	chanical Engineering,	Focus Materials in
Following Curricula	Engineering Sciences: Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical I	Engineering, Focus Mat	erials in Engineering
	Sciences: Compulsory			
	Mechanical Engineering: Specialisation Materials in	Engineering Sciences: Compulsory		

Course L1090: Fundamentals	s of Mechanical Properties of Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Norbert Huber
Language	DE
Cycle	SoSe
Content	1. Introduction and overview
	2. Bonding and crystallography, stress, strain, linear elasticity
	3. Plasticity of metallic materials
	4. Dislocations: Structure, stress, strain, strain energy
	5. Dislocations: Motion and forces
	6. Partial dislocations, dislocation interactions, jogs and kinks
	7. Strengthening mechanisms
	8. Introduction to modelling of materials behaviour, classification of
	phenomena
	9. Linear and nonlinear elasticity
	10. Plasticity, tensile loading, cyclic loading
	11. Viscoelasticity, effects of loading history, creep, relaxation
	12. Viscoplasticity, overstress, rate sensitivity of metallic materials
	13. Identification of material parameters
Literature	Hull and Bacon: Introduction to Dislocations (1984)
	G. Gottstein: Physik. Grundlagen der Materialk. (2001)
	N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998)
	P. Haupt: Cont. Mechanics and Theory of Materials (2002)

Course L1123: Welding Technology		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer	
Language	DE	
Cycle		
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.	

	al Mathematics I
Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
	f. Sabine Le Borne
Admission Requirements Nor	le
Recommended Previous	Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematicians
Knowledge	basic MATLAB knowledge
	auto i iii a iii iii oo o
Educational Objectives After	er taking part successfully, students have reached the following learning results
Professional Competence	
<i>Knowledge</i> Stu	dents are able to
_	
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding
	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.
<i>Skills</i> Stu	dents are able to
3	
	implement, apply and compare numerical methods using MATLAB,
	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 Stu	dents are able to
	work together in betergappough, compaced tooms (i.e. tooms from different study programs and background knowledge)
	work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), work together in heterogeneously composed teams (i.e., teams from differe
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.
Autonomy Stu	dents 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.
Mouldond in House Ind	and doub Church Time 124. Church Time in Landaure 56
	ependent Study Time 124, Study Time in Lecture 56
Credit points 6	
Examination Wri	
+	tten exam minutes
+	
Examination duration and 90 scale	
Examination duration and 90 scale Assignment for the Ger	minutes
Examination duration and 90 scale Assignment for the Following Curricula Ger	minutes neral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Examination duration and 90 scale Assignment for the Following Curricula Gereal Englishment Scale	minutes neral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in
Examination duration and scale Assignment for the Following Curricula Gerea	minutes neral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in gineering Sciences: Compulsory
Examination duration and scale Assignment for the Following Curricula Ger Eng Ger Ger	minutes neral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in gineering Sciences: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Examination duration and scale Assignment for the Following Curricula Ger Eng Ger Ger Corricula Corricula Ger Cor	minutes neral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in gineering Sciences: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: npulsory
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Examination duration and scale Assignment for the Following Curricula Ger Ger Ger Ger Ger Eng Ger Eng Ger Eng Ger Eng Ger Eng	minutes meral Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in gineering Sciences: Compulsory meral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: mpulsory meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical gineering: Elective Compulsory meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical gineering: Compulsory
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Course L0417: Numerical Mathematics I		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	DE/EN	
Cycle	WiSe	
Content	 Error analysis: Number representation, error types, conditioning and stability Interpolation: polynomial and spline interpolation Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas Linear systems: LU and Cholesky factorization, matrix norms, conditioning Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization Eigenvalue problems: power iteration, inverse iteration, QR algorithm Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems 	
Literature	 Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer 	

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

Module M1009: Mater	rial Science Laboratory			
Courses				
Title		Тур	Hrs/wk	СР
Companion Lecture for Materials Science Laboratory (L1088)		Lecture	2	2
Material Science Laboratory (L1235	5)	Practical Course	4	4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the techni	ical details of experiments in the a	area of materials sci	iences and illustrate
	respective relationships. They are capable of describ	ing and communicating relevant p	roblems and question	ns using appropriate
	technical language. They can explain the typical proce	ess of solving practical problems and	d present related resu	ults.
Skills	The students can transfer their fundamental knowled	dae on material ecionese to the pre	score of colving proc	tical problems. They
SKIIIS	identify and overcome typical problems during the rea	-		
	identity and overcome typical problems during the rea	silzation of experiments in the conte	Xt of illaterial science	cs.
Personal Competence				
Social Competence	Students are able to cooperate in small groups in orde	er to conduct experiments in the co	ntext of materials sci	ences. They are able
	to effectively present and explain their results alone of	or in groups in front of a qualified au	dience.	
Autonomy	Students are capable of solving problems in the conte	ext of materials sciences using pro-	vided literature. They	are able to fill gaps
	in as well as extent their knowledge using the literatu	- ·	-	a
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination	Written exam			
Examination duration and	1,5 h written Exam (50%) covering the lesson			
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Mech	anical Engineering,	Focus Materials in
Following Curricula	Engineering Sciences: Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Er	gineering, Focus Mat	erials in Engineering
	Sciences: Compulsory			
	Mechanical Engineering: Specialisation Product Develo	opment and Production: Compulsory	,	
	Mechanical Engineering: Specialisation Materials in En	ngineering Sciences: Compulsory		
	Product Development, Materials and Production: Tech	nical Complementary Course Core S	tudies: Elective Com	pulsory

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

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

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP
Introduction to Control Systems (LC Introduction to Control Systems (LC	
Module Responsible	
Admission Requirements	
-	Representation of signals and systems in time and frequency domain, Laplace transform
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties first and second order systems
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response
	root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	
	Students can transform models of linear dynamic systems from time to frequency domain and vice versa
	They can simulate and assess the behavior of systems and control loops They can design PID controllars with the halp of bewrittin (Zierler Nichele) turing rules.
	 They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
	They can calculate discrete-time approximations of controllers designed in continuous-time and use it for discrete-time approximations.
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Barranal Cammatana	
Personal Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use
Autonomy	when solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
	,,
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56
Credit points	Independent Study Time 124, Study Time in Lecture 56
Credit points Examination Examination duration and	Independent Study Time 124, Study Time in Lecture 56 6 Written exam
Credit points Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatrol Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechal
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Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering Science (German program, 7 semester): Specialisation Mec
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Tue Lecture	
Typ Lecture	
Hrs/wk 2	
CP 4	
Workload in Hours Independent Study Time 92, Study Time in Lecture 28	
Lecturer Prof. Herbert Werner	
Language DE	
Cycle WiSe	
Content Signals and systems	
Linear systems, differential equations and transfer functions	
First and second order systems, poles and zeros, impulse and step response	
Stability	
- 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 Post locus design of PID controllers	
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, Re	ading, MA, 2009
K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010	
R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010	

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

Caurage	
Courses	To United D
Title Computer Engineering (L0321)	Typ Hrs/wk CP Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	Prof. Heiko Falk
Admission Requirements	None
Recommended Previous	Basic knowledge in electrical engineering
Knowledge	,
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-le programming down to gates. The module includes the following topics:
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physicomposition of computer systems. The students can analyze, how highly specific and individual computers can be built based collection of few and simple components. They are able to distinguish between and to explain the different abstraction layer 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 completion.
	system and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Examination	Written exam
Examination duration and	90 minutes, contents of course and labs
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematical Engineering, Focus E
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M1005: Enhan	ced Fundamentals of Materials Science			
Courses				
Title		Тур	Hrs/wk	СР
Enhanced Fundamentals: Ceramics	and Polymers (L1233)	Lecture	2	2
Enhanced Fundamentals: Ceramics	and Polymers (L1234)	Recitation Section (large)	1	1
Enhanced Fundamentals: Metals (L1	L1086) Lecture 2 3			3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
Recommended Previous	Module "Fundamentals of Materials Science"			
Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	The students are able to give an enhanced overview over the fol	llowing topics		
	in metals, polymers and ceramics: Atomic bonds, crystal and	l amorphous structures, defect	s , electrical a	nd mass transport,
	microstructure and phase diagrams. They are capable to explain	the corresponding technical te	rms.	
Skills	The students are able to apply the appropriate physical and cher	mical methods for the above me	entioned subjec	ts.
Personal Competence				
Social Competence				
· ·	The students are capable to understand independently the structure	sture and propotice of coromics	motals and no	lymars. They should
	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge.			
	be able to critally evaluate the profoundness of their knowledge.	•		
Manda ad la Harra	Indiana dest Chada Time 110 Chada Time in Leature 70			
	Independent Study Time 110, Study Time in Lecture 70			
	6			
Examination				
	180 min			
scale				
_	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical	Engineering,	Focus Materials in
_	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engine	ering, Focus Pr	oduct Development
	and Production: Compulsory			
	General Engineering Science (English program, 7 semester): Spe	ecialisation Mechanical Engineer	ing, Focus Mate	erials in Engineering
	Sciences: Compulsory			
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engine	ering, Focus Pr	oduct Development
	and Production: Compulsory			
	Mechanical Engineering: Specialisation Materials in Engineering	, ,		
	Technomathematics: Specialisation III. Engineering Science: Elec	ctive Compulsory		

Course L1233: Enhanced Fun	damentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	
Content	1. Einführung
	Natürliche "Keramiken" - Steine
	"Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al203-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik
	Sprühtrockner
	3. Formgebung
	Arten der Formgebung
	Pressen (0 - 15 % Feuchte)
	Gießen (> 25 % Feuchte)
	Plastische Formgebung (15 - 25 % Feuchte)
	4. Sintern
	Triebkraft des Sinterns
	Effekt von gekrümmten Oberflächen und Diffusionswegen
	Sinterstadien des isothermen Festphasensinterns
	Herring scaling laws
	Heißisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten
	Bruchzähigkeit - Linear-elastische Bruchmechanik
	Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften
	Anwendungen
	Keramische Ionenleiter
	Jonischo Loitfähiakoit
	lonische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
Literature	
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	D. Munz, T. Fett, Ceramics, Springer, 2001
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe
	G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

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

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

Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2 3	3
Module Responsible				
Admission Requirements	None			
•	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important I and Organisation to Marketing and Innovation, and also			
	explain the differences between Economics an important definitions from the field of Manageme explain the most important aspects of and goals projects describe and explain basic business functions organization and human ressource management, explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and selections.	as production, procurement and si information management, innovation making in Business, esp. in situan mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain managemer d marketing
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular,		jectives, strateg	es etc.) and to car
	analyse Management goals and structure them a analyse organisational and staff structures of con apply methods for decision making under multipl analyse production and procurement systems an analyse and apply basic methods of marketing select and apply basic methods from mathematic apply basic methods from accounting, costing an	panies e objectives, under uncertainty and ur I Business information systems al finance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an e to communicate appropriately and to cooperate respectfully with their fellow studen Students are able to work in a team and to organize the team themsel	s.	oherent report on	the project
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
<u> </u>	Subject theoretical and practical work			
	several written exams during the semester			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Enginee	ering: Compulsor	,
Following Curricula	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme	ster): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 seme			ry
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme		_	
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering, I	ocus Mechatroni
	Compulsory General Engineering Science (German program, 7 :	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory	mostor). Specialisation Mashawin-1	Engineerina F-	us Aircraft Cust-
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7	•		-
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 sem		-	
	and Production: Compulsory General Engineering Science (German program, 7 se	mester): Specialisation Mechanical I	Engineering, Foc	us Energy Syster
				5, -, -

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory
Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP 3

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Lecturer Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek

Language DE

le WiSe/SoSe

Cycle Wis

Content In the m

In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.

If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on so selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Focus 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.

Taulo Pioss/T Auva	nced Mechanical Engineering	Design		
Courses				
Title Advanced Mechanical Engineering	=	Typ Lecture	Hrs/wk	CP 2
Advanced Mechanical Engineering Advanced Mechanical Engineering		Recitation Section (large) Lecture	2	1 2
dvanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	 Fundamentals of Mechanical Engineer 	ering Design		
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence	1			
Knowledge	After passing the module, students are able	e to:		
	 explain complex working principles a 	and functions of machine elements and of basic ele	ements of fluidics	i,
		ria, application scenarios and practical examples o		
	indicate the background of dimension	ning calculations.		
Skills	After passing the module, students are able	e to:		
	accomplish dimensioning calculation transfer knowledge learned in the my	s of covered machine elements, odule to new requirements and tasks (problem sol	vina ekille)	
	recognize the content of technical dr		villy skills),	
	evaluate complex designs, technicall			
Personal Competence				
Social Competence				
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Students are able to discuss technical	al information in the lecture supported by activatin	g methods.	
Autonomy				
		deepen their acquired knowledge in exercises. Onal knowledge and to recapitulate poorly unders	tood content a c	hy using the vid
	recordings of the lectures.	mai knowledge and to recapitulate poorly unders	tood content e.g	j. by using the viu
Mouldeed in Herry		Lockium 112		
Workload in Hours Credit points				
-	Written exam			
Examination duration and	120			
scale	,			
Assignment for the	General Engineering Science (German prog	ram): Specialisation Mechanical Engineering, Focu	s Energy System	is: Compulsory
		ogram): Specialisation Mechanical Engineering,		
-	Compulsory			
	General Engineering Science (German prog	gram): Specialisation Mechanical Engineering, Foc	us Materials in E	ingineering Science
	Compulcory			
	Compulsory			
	General Engineering Science (German prog	ram): Specialisation Mechanical Engineering, Focu		
	General Engineering Science (German prog General Engineering Science (German p	ram): Specialisation Mechanical Engineering, Focu orogram): Specialisation Mechanical Engineering		
	General Engineering Science (German prog General Engineering Science (German p Production: Compulsory	- · ·	g, Focus Produc	t Development a
	General Engineering Science (German prog General Engineering Science (German p Production: Compulsory	orogram): Specialisation Mechanical Engineering	g, Focus Produc	t Development a
	General Engineering Science (German prog General Engineering Science (German p Production: Compulsory General Engineering Science (German Engineering: Compulsory General Engineering Science (German pr	orogram): Specialisation Mechanical Engineering	ງ, Focus Produc	t Development a
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	General Engineering Science (German prog General Engineering Science (German prog Production: Compulsory General Engineering Science (German Engineering: Compulsory General Engineering Science (German pr Engineering: Compulsory General Engineering Science (German progression of the progression of	program): Specialisation Mechanical Engineering program): Specialisation Mechanical Engineer program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical	g, Focus Producting, Focus The Engineering, Focus and Engineering,	eoretical Mechanicus Aircraft Syste Focus Materials
	General Engineering Science (German prog General Engineering Science (German prog Production: Compulsory General Engineering Science (German Engineering: Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Engineering Science (German prog General Engineering Science (German prog Compulsory	program): Specialisation Mechanical Engineering program): Specialisation Mechanical Engineer program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical	g, Focus Producting, Focus The Engineering, Focus and Engineering, all Engineering,	eoretical Mechanicus Aircraft Syste Focus Materials Focus Mechatroni
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General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences:

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory

Course L0264: Advanced Me	chanical Engineering Design II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	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. Maschinenalenante Bandel III Manager, G. Greinene Maschinen although Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen und Konstruktionselemente, Sträckiller W. Päner P. Springer Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

Course L0262: Advanced Me	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	 Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	 Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Auf Die Din Die
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-6; Schleberg Parabourg About des Authorities 1 - Continue Verlag and Authorities 2 - Continue Verlag and Authorit
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage
	Auflage. • Poloff Match Maschinene Iomonto: Wittel H. Muhs, D. Jannasch, D. Voßiek, I. Springer Vieweg, 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
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0672: Signa	ls 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				
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	The modul is an introduction to the theory of signals and s	ystems. Good knowledge in maths	as covered by th	e moduls Mathematik
	1-3 is expected. Further experience with spectral transfor	mations (Fourier series, Fourier tra	ansform, Laplace	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the f	ollowing loarning results		
Professional Competence	Arter taking part successiony, students have reached the r	ollowing learning results		
•	The students are able to classify and describe signals and	linear time-invariant (ITI) systems	using methods	of signal and system
Knowiedge	theory. They are able to apply the fundamental transform			
	can describe and analyse deterministic signals and syste		_	
	understand the effects in time domain and image domai	•	-	
	discrete-time signal.	•		-
Skills	The students are able to describe and analyse determinist	ic signals and linear time-invariant	systems using n	nethods of signal and
	system theory. They can analyse and design basic sys	tems regarding important proper	ties such as ma	agnitude and phase
	response, stability, linearity etc They can assess the impa	act of LTI systems on the signal pro	perties in time ar	nd frequency domain
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information	from appropriate literature source	es. They can c	ontrol their level of
	knowledge during the lecture period by solving tutorial pro	blems, software tools, clicker syste	m.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisa	ation Electrical Engineering: Compu	Isory	
Following Curricula	General Engineering Science (German program): Specialisa	ation Computer Science: Compulsor	У	
	General Engineering Science (German program): Specialisa			
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	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanica	l Engineering, l	ocus Biomechanics:
	Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical I	Engineering, Foo	us Energy Systems:
	Compulsory			
	General Engineering Science (German program, 7 sem-	ester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systems
	Engineering: Compulsory		al Early	F
	General Engineering Science (German program, 7 se Engineering Sciences: Compulsory	mester): specialisation Mechanic	aı Engineering,	rocus Materiais in
	General Engineering Science (German program, 7 ser	mester): Specialisation Machanica	l Engineering	Focus Mechatronics
	Compulsory		. Engineering,	. ocas mechatronics.
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechanical
	Engineering: Compulsory	. ,	3.	
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisa	tion Civil- and Enviromental Engene	ering: Compulso	ory
	General Engineering Science (English program): Specialisa	tion Bioprocess Engineering: Comp	ulsory	
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	General Engineering Science (English program): Specialisa			
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	Compulsory		. 5.	
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical E	Engineering, Foo	us Energy Systems:
	1			

	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
S	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
И	Mechatronics: Core Qualification: Compulsory
т	Fechnomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Module M1320: Simul	ation and Design of Mechatronic Syste	ems		
Courses				
Title		Тур	Hrs/wk	СР
Simulation and Design of Mechatro	nic Systems (L1822)	Lecture	2	2
Simulation and Design of Mechatro	nic Systems (L1823)	Recitation Section (large)	1	2
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and electric	al engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations	for design, modeling, simulation and	optimization of m	echatronic systems.
Ckille	Students are able to apply modern algorithms for model	ing of machatronic systems. They sa	a identify cimula	to and docion cimple
SKIIIS	Students are able to apply modern algorithms for model systems and implement those in laboratory conditions.	ing of mechatronic systems. They can	ridentily, simula	te and design simple
	systems and implement those in laboratory conditions.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed g	roups and present results to target g	roups.	
Autonomy	Students are able to recognize and improve knowledge of	Students are able to recognize and improve knowledge deficits independently.		
	With instructor assistance, students are able to evaluate	their own knowledge level and defin	e a further course	e of study.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Mechanica	l Engineering, I	ocus Mechatronics:
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, Foo	us Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechanical
	Engineering: Elective Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanica	I Engineering, I	ocus Mechatronics:
	Compulsory		F	Aircraft Contains
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical	Engineering, Foo	us Aircraft Systems
	Engineering: Compulsory General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical Engir	neering Focus Th	enretical Mechanical
	Engineering: Elective Compulsory	Sec. 7. Specialisation Mechanical Eligii	iccinig, rocus III	coretical Mechanical
	Mechanical Engineering: Specialisation Aircraft Systems	Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Co			
	Mechanical Engineering: Specialisation Theoretical Mech			
	Mechanical Engineering: Specialisation Theoretical Mech		ory	
	Mechatronics: Core Qualification: Compulsory			

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

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

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

Module M0708: Electr	ical Engineering III: Circuit Theory and Trans	sients		
Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	•			
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence		· · · · · ·		
Knowledge	Students are able to explain the basic methods for calculating e	lectrical circuits. They know	the Fourier seri	es analysis of linear
	networks driven by periodic signals. They know the methods fo	r transient analysis of linear	networks in tin	ne and in frequency
	domain, and they are able to explain the frequency behaviour and	I the synthesis of passive two	-terminal-circuit	S.
Skills	The students are able to calculate currents and voltages in line	•		-
	periodic signals. They are able to calculate transients in electrical			
	respective transient behaviour. They are able to analyse and t circuits.	o synthesize the frequency	benaviour of pa	assive two-terminal-
	encures.			
Personal Competence				
	Students work on exercise tasks in small guided groups. They	are encouraged to present	and discuss the	ir results within the
,	group.	,		
Autonomy	The students are able to find out the required methods for solving	g the given practice problem	s. Possibilities a	re given to test their
	knowledge during the lectures continuously by means of short			
	educational objectives. They can link their gained knowledge to ot	ther courses like Electrical En	gineering I and I	Mathematics I.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination				
Examination duration and	150 min			
scale	_			
Assignment for the	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical	Engineering, F	ocus Mechatronics:
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Spec	cialisation Electrical Engineer	ing: Compulsory	
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical	Engineering, F	ocus Mechatronics:
	Compulsory General Engineering Science (English program, 7 semester): Spec	ialisation Electrical Engineeri	na: Compulsory	
	Computational Science and Engineering: Specialisation II. Mathem			Isory
	Computational Science and Engineering: Specialisation in Mathematical Computational Science and Engineering: Specialisation Engineering		•	·==· J
	Mechatronics: Core Qualification: Compulsory	_	•	
	Technomathematics: Specialisation III. Engineering Science: Electi	ive Compulsory		

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

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

Courses		
	To Unated	CD.
Fitle Computer Engineering (L0321)	Typ Hrs/wk Lecture 3	CP 4
Computer Engineering (L0324)	Recitation Section (small)	2
Module Responsible	e Prof. Heiko Falk	
Admission Requirements	s None	
Recommended Previous	s Basic knowledge in electrical engineering	
Knowledge	e	
Educational Objectives	s After taking part successfully, students have reached the following learning results	
Professional Competence	е	
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers to programming down to gates. The module includes the following topics:	from the assembly
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational 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 connection 	
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal st composition of computer systems. The students can analyze, how highly specific and individual computers collection of few and simple components. They are able to distinguish between and to explain the different 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 the configuration of the module, the students are able to judge the interdependencies between the configuration of the module, the students are able to judge the interdependencies between the configuration of the module.	s can be built based ent abstraction lay een a physical com
Personal Competence	system and the software executed on it. In particular, they shall understand the consequences that the ex- on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will the impact that these low abstraction levels have on an entire system's performance and to propose feasib	l be enabled to eva
	e Students are able to solve similar problems alone or in a group and to present the results accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with o	other classes.
Workload in Hours	s Independent Study Time 124, Study Time in Lecture 56	
Credit points	s 6	
Examination	Written exam	
Examination duration and	90 minutes, contents of course and labs	
scale	e	
Assignment for the	e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	у
Following Curricula	a General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Comp	ulsory
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Courses			
Fitle ntroduction to Control Systems (LC	Typ 1654) Lecture	Hrs/wk	CP 4
ntroduction to Control Systems (LC		2	2
Module Responsible	Prof. Herbert Werner		
Admission Requirements	None		
Recommended Previous	Representation of signals and systems in time and frequency domain, Laplace transform		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students can represent dynamic system behavior in time and frequency domain, and ca	an in particular	explain properties o
	first and second order systems		
	They can explain the dynamics of simple control loops and interpret dynamic properties	in terms of free	quency response an
	root locus		
	They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control long.		
	 They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency 	response	
	They can explain issues arising when controllers designed in continuous time domain are		digitally
		·	3 ,
Skills	Students can transform models of linear dynamic systems from time to frequency domain	in and vice vers	a
	They can simulate and assess the behavior of systems and control loops		
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules		
	They can analyze and synthesize simple control loops with the help of root locus and free They can apply the disprete time approximations of particular designed in apply		
	 They can calculate discrete-time approximations of controllers designed in conti implementation 	nuous-time and	a use it for digit
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out	these tasks	
Personal Competence	Chudante can walk in small waying to iniath, call a technical walkland, and a maxima attall, walld	ata thair cantra	llar dasiana
Autonomy	Students can work in small groups to jointly solve technical problems, and experimentally valid Students can obtain information from provided sources (lecture notes, software documental		
Autonomy	when solving given problems.	ion, experimen	it galaes) alla ase
	They can assess their knowledge in weekly on-line tests and thereby control their learning prog	iress.	
	They can assess their knowledge in weekly on-line tests and thereby control their learning prog	iress.	
	They can assess their knowledge in weekly on-line tests and thereby control their learning prog	iress.	
Workload in Hours		iress.	
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56	iress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56	Iress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56 6 Written exam	iress.	
Credit points Examination	Independent Study Time 124, Study Time in Lecture 56 6 Written exam	iress.	
Credit points Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 Written exam		
Credit points Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 Written exam 120 min	Compulsory	ory
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

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 Sign and account adds systems pales and respectively and step respectively.
	 First and second order systems, poles and zeros, impulse and step response Stability
	• 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 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
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Literature	
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
L	

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0777: Semic	onductor Circuit Design			
Courses				
Title Semiconductor Circuit Design (L076		Typ Lecture	Hrs/wk	CP 4
Semiconductor Circuit Design (L086		Recitation Section (small)	1	2
Module Responsible				
-	None Fundamentals of electrical engineering			
Kecommended Previous Knowledge	rundamentals of electrical engineering			
Kilowicage	Basics of physics, especially semiconductor physics			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	 Students are able to explain the functionality of di Students are able to explain how analog circuits for the students are able to explain the functionality of further students know the fundamental digital logic circuits. Students have knowledge about memory circuits. Students know the appropriate fields for the use of the students. 	unctions and where they are applied. Indamental operational amplifiers and ts and can discuss their advantages a and can explain their functionality and	d their specificati and disadvantage	
Skills	 Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits. Students are able to develop different logic circuits and can design different types of logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. 		ctronic circuits.	
Personal Competence Social Competence	Students are able work efficiently in heterogeneous Students working together in small groups can solution.		questions.	
Autonomy	Students are able to assess their level of knowled	ge.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
•	General Engineering Science (German program, 7 semes			
_	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, I	Focus Mechatronics:
	Compulsory Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semest	er): Specialisation Electrical Engineer	ing: Compulsory	
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanica	l Engineering, F	ocus Mechatronics:
	Compulsory			
	Computational Science and Engineering: Specialisation II		: Elective Compu	llsory
	Mechanical Engineering: Specialisation Mechatronics: Co	mpulsory		
	Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Scien	nce: Elective Compulsory		
		core company		

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

Course L0864: Semiconducto	or Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	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: 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/jmg/bo

Module M0854: Matho	ematics IV			
Courses				
Title		Тур	Hrs/wk	CP
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) Complex Functions (L1042)		Recitation Section (small) Recitation Section (large)	1	1
	Prof. Anusch Taraz	Recitation Section (large)	1	1
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	Arter taking part successivily, students have reached the	Tollowing learning results		
Knowledge				
Knowieuge	Students can name the basic concepts in Mathema	atics IV. They are able to explain then	n using appropri	ate examples.
	 Students can discuss logical connections between 	these concepts. They are capable $% \begin{center}	of illustrating th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce the 	m.		
Skills	Chudonto an model publishes in Mathematica IV	with the help of the concepts studie	d in this source	Maraayar thay are
	 Students can model problems in Mathematics IV capable of solving them by applying established m 		a in this course	. Moreover, they are
	Students are able to discover and verify further log		ate studied in the	COURSE
	For a given problem, the students can develop a			
	results.	and execute a suitable approach, an	id are able to c	itically evaluate the
	resurts.			
Barraral Carractoria				
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 new concepts			-
	design examples to check and deepen the underst	anding of their peers.		
Autonomy				
	Students are capable of checking their understand		wn. They can sp	ecify open questions
	precisely and know where to get help in solving th			
	Students have developed sufficient persistence to	be able to work for longer periods	in a goal-orien	ted manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equati	ons 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Enginee	ring: Compulsory	/
Following Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Mechanica	Engineering, I	ocus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (German program, 7 semes		e: Compulsory	
	Computer Science: Specialisation Computational Mathem	atics: Elective Compulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semest	· ·		
	General Engineering Science (English program, 7 se	emester): Specialisation Mechanical	Engineering, I	ocus Mechatronics:
	Compulsory	ton). Consisting the state of the state of		e emphised Martin
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory	or). Specialization Mayor Architecture	Compular	
	General Engineering Science (English program, 7 semest			dean.
	Computational Science and Engineering: Specialisation II.			пьогу
	Computational Science and Engineering: Specialisation C	·	-	
	Computational Science and Engineering: Specialisation E		sur y	
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Machatronics: Co.			
	Mechanical Engineering: Specialisation Mechatronics: Con	npulsory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	antany Course Core Studies Floor	Compulsor	
	Theoretical Mechanical Engineering: Technical Compleme	antary Course Core Studies: Elective (Lompulsory	

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 Ed	ourse 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	
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 SoSe	
Content	Main features of complex analysis	
Literature	 Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

Course L1041: Complex Functions	
Тур	Recitation Section (small)
Hrs/wk	1
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 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
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2	3
Module Responsible				
Admission Requirements				
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Plan and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
	explain the differences between Economics an important definitions from the field of Managemer explain the most important aspects of and goals projects describe and explain basic business functions organization and human ressource management, explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and sele	t in Management and name the mos as production, procurement and s information management, innovation making in Business, esp. in situa in mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain manageme nd marketing
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular,		ojectives, strateg	ies etc.) and to ca
	 analyse Management goals and structure them ap analyse organisational and staff structures of com apply methods for decision making under multiple analyse production and procurement systems and analyse and apply basic methods of marketing select and apply basic methods from mathematics apply basic methods from accounting, costing and 	panies objectives, under uncertainty and un Business information systems Il finance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves 			
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
· · · · · · · · · · · · · · · · · · ·	Subject theoretical and practical work			
	several written exams during the semester			
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 semes	ter): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 semes			ory
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 semes		_	
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	il Engineering,	rocus Mechatroni
	Compulsory General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (German program, 7 se Engineering: Compulsory	mester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syste
	General Engineering Science (German program, 7 Engineering Sciences: Compulsory	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	General Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme: Engineering: Compulsory	ster): Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechani
	General Engineering Science (German program, 7 seme and Production: Compulsory	ster): Specialisation Mechanical Eng	ineering, Focus F	Product Developme
	General Engineering Science (German program, 7 set	nester): Specialisation Mechanical I	Engineering, Foc	us Energy Systen

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	108821	Management	Tutorial
Course	LUUUZ.	Management	Tutoriai

Recitation Section (large) Тур

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias VIcek Lecturer

DE Language

Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Focus Product Development and Production

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

Module M0597: Adva	nced Mechanical Engineering Desig	gn		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
Advanced Mechanical Engineering	_	Recitation Section (large)	2	1
Advanced Mechanical Engineering	Design I (L0262)	Lecture	2	2
Advanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	 Fundamentals of Mechanical Engineering De 	esian		
Knowledge	Mechanics	9		
	Fundamentals of Materials Science			
	Production Engineering			
	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and fund	ctions of machine elements and of basic ele	ements of fluidics	,
	explain requirements, selection criteria, app	olication scenarios and practical examples	of complex machi	ne elements,
	indicate the background of dimensioning ca	lculations.		
Ckilla	After passing the module students are able to			
SKIIIS	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered to the control of the contro	vered machine elements,		
	transfer knowledge learned in the module to	o new requirements and tasks (problem so	ving skills),	
	recognize the content of technical drawings	and schematic sketches,		
	 evaluate complex designs, technically. 			
Personal Competence				
Social Competence				
	Students are able to discuss technical inform	mation in the lecture supported by activatir	ng methods.	
Autonomy				
raconomy	Students are able to independently deepen	their acquired knowledge in exercises.		
	• Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video			
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture	e 112		
Credit points	, , , , , , , , , , , , , , , , , , , ,			
	Written exam			
Promise the description and	120			
Examination duration and	120			
scale	Canaval Faminacuing Caianae (Carneen myaguan).	Consisting Machanian Franciscoving Foot	o Engany Cyatana	s. Commulasm.
_	General Engineering Science (German program): S			
Following Curricula	General Engineering Science (German program) Compulsory	. Specialisation Mechanical Engineering,	Tocus Aliciait 3	ysterns Engineering
	General Engineering Science (German program):	Specialisation Mechanical Engineering, Foo	us Materials in E	naineerina Sciences
	Compulsory	,		3
	General Engineering Science (German program): S	Specialisation Mechanical Engineering, Focu	ıs Mechatronics: (Compulsory
	General Engineering Science (German program	n): Specialisation Mechanical Engineering	g, Focus Produc	t Development and
	Production: Compulsory			
	General Engineering Science (German progra	am): Specialisation Mechanical Enginee	ring, Focus The	eoretical Mechanica
	Engineering: Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanic	cal Engineering,	Focus Materials in
	Engineering Sciences: Compulsory	. 7	. Facility is a	Farm Mark 1
	General Engineering Science (German program	n, / semester): Specialisation Mechanica	ai Engineering,	rocus Mechatronics
	Compulsory Congral Engineering Science (Gorman program 3	I competer). Specialization Machanias! For	incoring Facus 5	Product Dovolance
	General Engineering Science (German program, 7 and Production: Compulsory	semester). Specialisation Mechanical Eng	meemig, rocus F	Toduct Developmen
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	neering Focus Th	neoretical Mechanica
	Engineering: Compulsory	semester). Specialisation Mechanical Engi	neering, rocus II	ieoreticai Metriallica
	General Engineering Science (German program	n. 7 semester): Specialisation Mechanica	al Engineering F	ocus Biomechanics
	Compulsory	., . semester, specialisation ricellatile	Linguiscoining, I	2.22 Diomechanics
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Systems
	Compulsory			
	General Engineering Science (English program): Sp	pecialisation Mechanical Engineering, Focus	s Energy Systems	: Compulsory
	•			

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

Course L0264: Advanced Me	chanical Engineering Design II		
	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
Content	Advanced Mechanical Engineering Design I & II		
	Lecture		
	Fundamentals of the following machine elements:		
	 Linear rolling bearings 		
	Axes & shafts		
	Seals		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank drives		
	Sliding bearings		
	Elements of fluidics		
	Exercise		
	Calculation methods of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank gears		
	Sliding bearings		
	Calculations of hydrostatic systems (fluidics)		
Literature			
	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. 		
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. 		
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 		
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.		
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	• Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle		
	Auflage.		
	• Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.		
	Sowie weitere Bücher zu speziellen Themen		
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Course L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0262: Advanced Me	chanical Engineering Design I		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer			
Language			
Cycle			
Content			
	Lecture		
	Fundamentals of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Seals		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank drives		
	Sliding bearings		
	Elements of fluidics		
	Exercise		
	Calculation methods of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank gears		
	Sliding bearings		
	Calculations of hydrostatic systems (fluidics)		
Literature			
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.		
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 		
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. 		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle 		
	Auflage.		
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.		
	Sowie weitere Bücher zu speziellen Themen		

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

Module M0725: Produ	action Engineering			
Courses				
Title Production Engineering I (L0608) Production Engineering I (L0612) Production Engineering II (L0610)		Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	CP 2 1 2
Production Engineering II (L0611)		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge	no course assessments required internship recommended			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence Knowledge	Name basic criteria for the selection of man name the main groups of Manufacturing Te name the application areas of different man name boundaries, advantages and disadval describe elements, geometric properties an explain the essential models of manufactur	chnology. nufacturing processes. ntages of the different manufacturing proce nd kinematic variables and requirements for		and process.
Skills	select manufacturing processes in accordar design manufacturing processes for simple assess components in terms of their produce	tasks to meet the required tolerances of th	e component to b	e produced.
Personal Competence Social Competence	Students are able to • develop solutions in a production environm	ent with qualified personnel at technical lev	vel and represent	decisions.
Autonomy	Students are able to interpret independently the manufacturing assess own strengths and weaknesses in ge assess their learning progress and define g assess possible consequences of their action	eneral. gaps to be improved.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points				
Examination				
Examination duration and	120 min			
scale Assignment for the	General Engineering Science (German program, 7	competer). Specialisation Machanical Frai	nooring Facus Th	poorotical Machanica
•	Engineering: Elective Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (English program, 7 Engineering: Elective Compulsory General Engineering Science (English program, 7 and Production: Compulsory Logistics and Mobility: Specialisation Engineering	7 semester): Specialisation Mechanical Enginesemester): Specialisation Mechanical Enginesemester): Specialisation Mechanical Enginesemester): Specialisation Mechanical Enginesemester): Specialisation Mechanical Enginesemes	ineering, Focus F	Product Development
	Mechanical Engineering: Core Qualification: Comp Mechatronics: Core Qualification: Compulsory	uisory		

Course L0608: Production En	gineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	 Manufacturing Accuracy Manufacturing Metrology Measurement Errors and Uncertainties Introduction to Forming Massiv forming and Sheet Metal Forming Introduction to Machining Technology Geometrically defined machining (Turning, milling, drilling, broaching, planning)
	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 Engineering I	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0610: Production Er	ngineering II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology 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 Engineering II	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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

Module M0596: Advar	nced Mechanical Design Project	
Courses		
Title	Typ Hrs/wk C	Р
Advanced Mechanical Design Project	ect (L0266) Project-/problem-based Learning 4 6	
Module Responsible	Dr. Jens Schmidt	
Admission Requirements	None	
Recommended Previous	Mechanical Engineering: Design	
Knowledge	Advanced Mechanical Engineering Design	
	Advanced Rechanical 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 th	e 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 selecting
	appropriate methods,	
	to independently solve problems.	
Workload in House	Independent Study Time 124, Study Time in Lecture 56	
Workload in Hours Credit points		
	Written exam	
Examination duration and		
scale		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Air	rcraft Systom
-	Engineering: Compulsory	iciaii systems
Tollowing curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product	t Developmen
	and Production: Compulsory	- 50.0.0pmen
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoreti	ical Mechanica
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Air	rcraft Systems
	Engineering: Compulsory	.,
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product	t Developmen
	and Production: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoreti	cal Mechanica
	Engineering: Compulsory	
	Mechanical Engineering: Core Qualification: Compulsory	
	<u> </u>	

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

Module M0726: Production Technology				
Courses				
Title Fundamentals of Machine Tools (L0 Fundamentals of Machine Tools (L1 Forming and Cutting Technology (L6	992) 0613)	Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	CP 2 1 2
Forming and Cutting Technology (LC	0614)	Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
·	None			
	without major course assessment			
Knowledge	internship recommended			
	Previous knowledge in mathematics, mechanics and ele	ctrical engineering		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence	-	·		
Knowledge	Students are able to			
	 explain the basics of chip formation and mechani explain methods and parameters for design and a explain technical concepts of machine tool buildin explain types, constructions and functions of CNC explain equipment components. 	analysis of metal forming, machining pand give an overview on trends in t	the machine tool	industry.
Skills	Students are able to			
	 select tool geometry, cutting materials, process requirements. estimate occurring forces and temperatures durin select appropriate machine tools for machining a assess the quality of a machine tools and to dete 	ng chip formation. nd create NC programs for turning and		accordance with the
Personal Competence	Charles the area able to			
social Competence	develop solutions in a production environment wi	th qualified personnel at technical lev	el and represent	decisions.
Autonomy	Students are able to			
	interpret independently cutting processes.			
	create independently NC programs.			
	• select independently machine tools by reference	to appropriate requirements.		
	assess own strengths and weaknesses in general			
	assess their learning progress and define gaps to	be improved.		
	 assess possible consequences of their actions. 			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Eng	ineering, Focus I	Product Development
Following Curricula	and Production: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engi	neering, Focus F	Product Development
	and Production: Compulsory	mont and Broduction. Commuter:		
	Mechanical Engineering: Specialisation Product Develop Product Development, Materials and Production: Techni-		es: Flective Com	inulsory
		ca. complementary course core studi	LICCUVE COIII	, p a 1501 y

Course L0689: Fundamentals	of Machine Tools
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Thorsten Schüppstuhl
Language	
Cycle	Terminology and trends in machine tool building
30.113.113	
	CNC controls
	NC programming and NC programming systems
	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
Literature	Conrad K I
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
	ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006

Course L1992: Fundamentals of Machine Tools	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	 Thermomechanical Principles and Models of Machining Chip Formation, Forces, Temperature and Tribology process Wear mechanisms and wear patterns Machinability by Cutting and Forming, Specific Problems of Light Weight Structures Cutting Material and Coatings Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools 	
Literature	Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002) Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004) König, W., Klocke, F.; Fertigungsverfahren Bd. 4 <i>Massivumformung</i> , 4. Auflage, VDI-Verlag (1996) König, W., Klocke, F.; Fertigungsverfahren Bd. 5 <i>Blechbearbeitung</i> , 3. Auflage, VDI-Verlag (1995) Klocke, F., König, W.; Fertigungsverfahren <i>Schleifen, Honen, Läppen</i> , 4. Auflage, Springer Verlag (2005) König, W., Klocke, F.: Fertigungsverfahren <i>Drehen, Fräsen, Bohren,</i> 7. Auflage, Springer Verlag (2002)	

Course L0614: Forming and Cutting Technology	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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 M0730: Comp	uter Engineering
Courses	
Title	Typ Hrs/wk CP
Computer Engineering (L0321)	Typ Hrs/wk CP Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	Prof. Heiko Falk
Admission Requirements	None
Recommended Previous	Basic knowledge in electrical engineering
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-leve
	programming down to gates. The module includes the following topics:
	Introduction
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks
	Sequential logic: Flip-flops, automata, systematic hardware design
	Technological foundations
	Computer arithmetic: Integer addition, subtraction, multiplication and division
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining
	Memories: Memory hierarchies, SRAM, DRAM, caches
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physica
	composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a
	collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers o
	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 computer
	After successful completion of the module, the students are able to judge the interdependencies between a physical compute system and the software executed on it. In particular, they shall understand the consequences that the execution of software has
	on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate
	the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence	
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
-	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Examination	Written exam
Examination Examination duration and	
Examination Examination duration and scale	Written exam 90 minutes, contents of course and labs
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory
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Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
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Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
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Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
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Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen and Production: Compulsory Compulsory Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computer Science: Core Qualification: Compulsory
Examination Examination duration and scale Assignment for the	Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineerin
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP
ntroduction to Control Systems (LC	
Introduction to Control Systems (LC	
Module Responsible	
Admission Requirements	
Kecommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform
Kilowieuge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	Price raking part successfully, stauches have reached the following realiting results
Knowledge	
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties
	first and second order systems
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response a reat locus.
	 root locus They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the Nyquist stability Chiefforf and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the voice of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	Students can transform models of linear dynamic systems from time to frequency domain and vice versa
	They can simulate and assess the behavior of systems and control loops
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules
	They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques
	• They can calculate discrete-time approximations of controllers designed in continuous-time and use it for dig
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use
	when solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
	They can assess their knowledge in weekly off-line tests and aftereby control their fearthing progress.
	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Credit points Examination	6 Written exam
Credit points Examination Examination duration and	6 Written exam
Credit points Examination Examination duration and scale	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: 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 Product Development
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus The
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsory Bioprocess Engineering Science (German program, 7 semester): S
Credit points Examination 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 Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Frocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Projectory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster Compulsory General Engineering Science (German program, 7 semester): Specia

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	co 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
	reeuback 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. Farabilia, J.B. Ravalla and A. Farabilia Note in the Addition Medical Medica
	G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 Control Medicar Control Engineering Tourists Edition Prophics Use II, Upper Soddills Birgs, NJ, 2010 Control Medicar Control Engineering Tourists Edition Prophics Use II, Upper Soddills Birgs, NJ, 2010
	 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
	- N.C. Don and N.H. Dishop, Prodein Control Systems, Addison Wesley, Reduing, MA 2010

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0599: Integr	rated Product Development and Lightweight	: Design			
Courses					
Title CAE-Team Project (L0271) Development of Lightweight Design	Products (L0270)	Typ Project-/problem-based Learning Lecture	Hrs/wk 2 2	CP 2 2	
Integrated Product Development I (Lecture	2	2	
•	Prof. Dieter Krause				
	None				
Recommended Previous Knowledge	Advanced Knowledge about engineering design: Fundamentals of Mechanical Engineering Design				
	Mechanical Engineering: Design				
	Advanced Mechanical Engineering Design				
	After taking part successfully, students have reached the following	ig learning results			
Professional Competence Knowledge	After completing the module, students are capable of:				
	 explaining the functional principle of 3D-CAD-Systems, PDI describing the interaction of the different CAE-Systems in the contract of the con		SS		
Skills					
	After completing the module, students are able to:				
	 evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification schemes an product structuring design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload 				
Personal Competence Social Competence	After completing the module, students are able to:				
	 To develop a project plan and allocate work appropriate we Present project results as a team for instance in a present 		of group discu	ssions	
Autonomy	Students are capable of:				
	 independently adapt to a CAE-Tool and complete a given p 	practical task with it			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		<u> </u>		
Credit points	6				
Examination	Written exam				
Examination duration and	90				
scale					
Assignment for the	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Eng	ineering, Focu	ıs Aircraft Systems	
Following Curricula	Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp	posialisation Moshanisal Engine	oring Facus Dr	adust Davalanment	
	and Production: Compulsory	ecialisation Mechanical Enginee	ering, rocus ri	oddet Development	
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Eng	ineering, Focu	s Aircraft Systems	
	Engineering: Compulsory		3		
	General Engineering Science (English program, 7 semester): Sp and Production: Compulsory	ecialisation Mechanical Enginee	ering, Focus Pr	oduct Development	
	Mechanical Engineering: Specialisation Product Development and				
	Mechanical Engineering: Specialisation Aircraft Systems Engineer Product Development, Materials and Production: Technical Comp		Elective Comp	ulsory	

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

Module M1005: Enhar	nced Fundamentals of Materials Scie	nce			
Courses					
Title		Тур	Hrs/wk	СР	
Enhanced Fundamentals: Ceramics	Lecture	2	2		
Enhanced Fundamentals: Ceramics		Recitation Section (large)	1	1	
Enhanced Fundamentals: Metals (L.	1086)	Lecture	2	3	
Module Responsible	Prof. Gerold Schneider				
Admission Requirements	None				
Recommended Previous	Module "Fundamentals of Materials Science"				
Knowledge	Module "Materials Science Laboratory"				
	Module "Advanced Materials"				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students are able to give an enhanced overview of	over the following topics			
	in metals, polymers and ceramics: Atomic bonds, of	rystal and amorphous structures, def	ects , electrical	and mass transport,	
	microstructure and phase diagrams. They are capable to explain the corresponding technical terms.				
Skills	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.				
Personal Competence					
Social Competence					
·	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should				
Autonomy	be able to critally evaluate the profoundness of their knowledge.				
	be able to critary evaluate the protourianess of their i	anowicage.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70			
Credit points	6	<u> </u>			
Examination	Written exam				
Examination duration and					
scale	100 11111				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Mechanic	al Engineering	Focus Materials in	
Following Curricula	Engineering Sciences: Compulsory	,			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical Eng	ineering. Focus F	roduct Development	
	and Production: Compulsory	, .,	5, 1 0		
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engine	eering, Focus Mat	terials in Engineering	
	Sciences: Compulsory		5,	59	
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical Eng	ineering, Focus P	roduct Development	
	and Production: Compulsory	. , ,	5, 1300		
	Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				
	, , , , , , , , , , , , , , , , , , , ,	11 3			

Course L1233: Enhanced Fun	damentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	
Content	1. Einführung
	Natürliche "Keramiken" - Steine
	"Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al2O3-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Pulveraufbereitung
	Mah ha shaile
	Mahltechnik Sprühtrockner
	3. Formgebung
	Arten der Formgebung
	Pressen (0 - 15 % Feuchte)
	Gießen (> 25 % Feuchte)
	Plastische Formgebung (15 - 25 % Feuchte)
	4. Sintern
	Triebkraft des Sinterns
	Effekt von gekrümmten Oberflächen und Diffusionswegen
	Sinterstadien des isothermen Festphasensinterns
	Herring scaling laws Heißisostatisches Pressen
	neibisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten
	Bruchzähigkeit - Linear-elastische Bruchmechanik
	Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften
	Anwendungen
	Keramische Ionenleiter
	Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
114	
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	D. Munz, T. Fett, Ceramics, Springer, 2001
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe
	G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €
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Course L1234: Enhanced Fundamentals: Ceramics and Polymers		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Courses					
Title		Тур	Hrs/wk	СР	
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2	3	
Module Responsible					
Admission Requirements	·				
•	Basic Knowledge of Mathematics and Business				
Knowledge					
Educational Objectives	After taking part successfully, students have reached th	ne following learning results			
Professional Competence					
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Pland Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to				
	explain the differences between Economics a important definitions from the field of Manageme explain the most important aspects of and goal projects describe and explain basic business functions organization and human ressource management explain the relevance of planning and decisio uncertainty, and explain some basic methods fro state basics from accounting and costing and sel	ent s in Management and name the mos as production, procurement and s , information management, innovation n making in Business, esp. in situa m mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain managemend marketing	
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular		ojectives, strateg	ies etc.) and to ca	
	 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 				
Personal Competence					
Social Competence	Students are able to				
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves 				
	to write a report on their project.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
· · · · · · · · · · · · · · · · · · ·	Subject theoretical and practical work				
	several written exams during the semester				
scale					
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Electrical Enginee	ering: Compulsor	у	
Following Curricula	General Engineering Science (German program, 7 seme	ester): Specialisation Process Engineer	ing: Compulsory		
	General Engineering Science (German program, 7 seme	ester): Specialisation Biomedical Engin	eering: Compulso	ory	
	General Engineering Science (German program, 7 seme	ester): Specialisation Naval Architectur	e: Compulsory		
	General Engineering Science (German program, 7 seme	ester): Specialisation Computer Science	e: Compulsory		
	General Engineering Science (German program, 7 seme			ory	
	General Engineering Science (German program, 7 seme				
	General Engineering Science (German program, 7 seme		_		
	General Engineering Science (German program, 7 Compulsory	semester): Specialisation Mechanica	ii Engineering,	rocus Mechatroni	
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani	
	Compulsory				
	General Engineering Science (German program, 7 sc Engineering: Compulsory			,	
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials	
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme Engineering: Compulsory	ester): Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechani	
	General Engineering Science (German program, 7 sem and Production: Compulsory	ester): Specialisation Mechanical Eng	ineering, Focus F	Product Developme	
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical	Engineering, Foo	us Energy Systen	

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management	Tutorial

Typ Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

Cvcle

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

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

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.

Module M0597: Adva	nced	Mechanical Engineering Design			
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design	II (L0264)	Lecture	2	2
Advanced Mechanical Engineering	Design	II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering	Design	I (L0262)	Lecture	2	2
Advanced Mechanical Engineering	Design	I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof.	Dieter Krause			
Admission Requirements	None				
Recommended Previous		Fundamentals of Machanical Funia anima Design			
Knowledge		Fundamentals of Mechanical Engineering Design Mechanics			
		Fundamentals of Materials Science			
		Production Engineering			
	•	Production Engineering			
Educational Objectives	After	taking part successfully, students have reached the fo	llowing learning results		
Professional Competence					
Knowledge	After	passing the module, students are able to:			
_					
		explain complex working principles and functions of			
		explain requirements, selection criteria, application s		of complex machi	ne elements,
	•	indicate the background of dimensioning calculations	5.		
Skills	After	passing the module, students are able to:			
		,			
	•	accomplish dimensioning calculations of covered ma	chine elements,		
		transfer knowledge learned in the module to new red		olving skills),	
		recognize the content of technical drawings and sche	ematic sketches,		
	•	evaluate complex designs, technically.			
Personal Competence					
Social Competence					
Social Competence	•	Students are able to discuss technical information in	the lecture supported by activat	ing methods.	
Autonomy					
Autonomy	•	Students are able to independently deepen their acq	uired knowledge in exercises.		
	•	Students are able to acquire additional knowledge	and to recapitulate poorly unde	rstood content e.g	. by using the video
		recordings of the lectures.			
Workload in Hours	Indon	endent Study Time 68, Study Time in Lecture 112			
	<u> </u>	endent study filme 66, study filme in Lecture 112			
Credit points					
Examination	-	en exam			
Examination duration and	120				
scale	<u> </u>				
_		ral Engineering Science (German program): Specialisa			
Following Curricula	Gene	ral Engineering Science (German program): Special	isation Mechanical Engineering	, Focus Aircraft S	ystems Engineering:
		pulsory			
		ral Engineering Science (German program): Specialis	ation Mechanical Engineering, Fo	ocus Materials in E	ngineering Sciences:
		pulsory			
		ral Engineering Science (German program): Specialisa			
		ral Engineering Science (German program): Speci	alisation Mechanical Engineeri	ng, Focus Product	Development and
		action: Compulsory			
		ral Engineering Science (German program): Spe	cialisation Mechanical Engine	ering, Focus The	oretical Mechanical
	_	eering: Compulsory			
		ral Engineering Science (German program, 7 seme	ster): Specialisation Mechanica	Engineering, Foo	us Aircraft Systems
	-	eering: Compulsory		ind Francisco	Faces Makedala is
		ral Engineering Science (German program, 7 sei	nester). Specialisation Mechan	iicai Engineening,	rocus Materiais III
	_	eering Sciences: Compulsory	and the state of t	aal Emminaaning I	Tagus Mashatranias
		ral Engineering Science (German program, 7 sen	lester). Specialisation Mechani	car Engineering, i	ocus Mechatronics.
		oulsory ral Engineering Science (German program, 7 semeste	er): Specialisation Mochanical En	gineering Focus B	roduct Development
		roduction: Compulsory	,. Specialisation rectianted El	galeering, 1 ocus P	. sauce Development
		ral Engineering Science (German program, 7 semeste	r): Specialisation Mechanical End	ineering Focus Th	eoretical Mechanical
		eering: Compulsory	.,. specialisation mechanical Eff	,ccinig, i ocus III	.corecieur Mechanical
	_	reering: Compuisory ral Engineering Science (German program, 7 sem	ester): Specialisation Mechanic	al Engineering F	ocus Biomechanics
		oulsory	social, openingunon mechanic	.a. Engineering, I	Joniechanics.
		ral Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineering Foo	us Enerav Systems
		oulsory	/i opecialisation Mechanica	gcci.iig, 100	
		ral Engineering Science (English program): Specialisat	ion Mechanical Engineering, Foc	us Enerav Svstems	: Compulsorv
		ral Engineering Science (English program): Special			
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Compulsory

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

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

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

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

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

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

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

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

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

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

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

Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

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

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

Course L0262: Advanced Med	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	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. Tieffikanse in die DIN Names auf den M. Tauka auf Verlag.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	 Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

	ls and Systems			
Courses				
Гitle	т	у р	Hrs/wk	СР
Signals and Systems (L0432)		ecture	3	4
Signals and Systems (L0433)	R	ecitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge	The modul is an introduction to the theory of signals and systems.	Good knowledge in maths as	covered by the	module Mathemati
	1-3 is expected. Further experience with spectral transformations			
	but not required.	(Fourier Series, Fourier train	sioiiii, Lapiace	transform, is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear t	ime-invariant (LTI) systems u	sing methods o	of signal and system
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. The			and systems. They
	can describe and analyse deterministic signals and systems mat	hematically in both time and	l image domair	n. In particular, they
	understand the effects in time domain and image domain which	are caused by the transition	n of a continue	ous-time signal to a
	discrete-time signal.			
Skills	The students are able to describe and analyse deterministic signal	s and linear time-invariant sy	stems using m	ethods of signal and
	system theory. They can analyse and design basic systems re	egarding important propertie	es such as ma	gnitude and phase
	response, stability, linearity etc They can assess the impact of LT	systems on the signal prope	rties in time an	d frequency domair
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from a	ppropriate literature sources	s. They can co	ontrol their level o
	knowledge during the lecture period by solving tutorial problems, s			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination				
	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisation Ele			
Following Curricula	General Engineering Science (German program): Specialisation Col			
	General Engineering Science (German program): Specialisation Pro			
	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program): Specialisation Civ	-		ory
	General Engineering Science (German program): Specialisation Me			
	General Engineering Science (German program): Specialisation Bio			
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	General Engineering Science (German program, 7 semester): Spec			n.
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	General Engineering Science (German program, 7 semester):			
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	Compulsory	pocianoación ricenamear En	giricering, rock	as Energy systems
	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical En	ngineering Foc	us Aircraft System
	Engineering: Compulsory		.gcomig, 100	cruit Systelli
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	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Specengineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program): Specialisation Civit General Engineering Science (English program): Specialisation Biograms	Specialisation Mechanical Enginerical Enginerical Enginerical Engineerical Engineer	Engineering, F ering, Focus Th ring: Compulsor sory	ocus Mechatronics
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	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Specific Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program): Specialisation Civit General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Conference (English program): Specialisation Conference (English program): Specialisation Medical Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Programal Engineering Science (English program): Specialisation Program	Specialisation Mechanical Engineering: Compulsor Engineering: Engineering	Engineering, Fering, Focus The ring: Compulsor sory sory sory sory	ocus Mechatronics
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	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Specific Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program): Specialisation Civit General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Conferenal Engineering Science (English program): Specialisation Conferenal Engineering Science (English program): Specialisation Medical Engineering Science (English program): Specialisation Programal Engineering Science (English program): Specialisation Programal Engineering Science (English program, 7 semester): Special General Engineering Science (English program, 7 semester): Special Science (En	Specialisation Mechanical Enginerical Engineering: Compulsor Computer Science: C	Engineering, Fering, Focus The ring: Compulsor sory sory sory (rig: Compulsory Compulsory : Compulsory ing: Compulsory ing: Compulsory ing: Compulsory	focus Mechatronics eoretical Mechanics
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Specific Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program): Specialisation Civit General Engineering Science (English program): Specialisation Electrical Engineering Science (English program): Specialisation Electrical Engineering Science (English program): Specialisation Confederal Engineering Science (English program): Specialisation Medical Engineering Science (English program): Specialisation Medical Engineering Science (English program): Specialisation Programal Engineering Science (English program, 7 semester): Special	Specialisation Mechanical Enginerical Engineering: Compulsor Computer Science: C	Engineering, F ering, Focus Th ring: Compulsor sory ery sory g: Compulsory Compulsory : Compulsory ing: Compulsory ing: Compulsor	focus Mechatronics eoretical Mechanics Ty y
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Specific Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program): Specialisation Civit General Engineering Science (English program): Specialisation Biogramal Engineering Science (English program): Specialisation Conferenal Engineering Science (English program): Specialisation Conferenal Engineering Science (English program): Specialisation Medical Engineering Science (English program): Specialisation Programal Engineering Science (English program): Specialisation Programal Engineering Science (English program, 7 semester): Special General Engineering Science (English program, 7 semester): Special Science (En	Specialisation Mechanical Enginerical Engineering: Compulsor Computer Science: C	Engineering, F ering, Focus Th ring: Compulsor sory ery sory g: Compulsory Compulsory : Compulsory ing: Compulsory ing: Compulsor	focus Mechatronics eoretical Mechanics Ty y

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

ation and Design of Mechatronic Sys	tems		
	Тур	Hrs/wk	СР
ic Systems (L1822)	Lecture	2	2
ic Systems (L1823)	Recitation Section (large)	1	2
ic Systems (L1824)	Practical Course	1	2
Prof. Uwe Weltin			
None			
Fundatmentals of mechanics, control theory and elect	rical engineering		
After taking part successfully, students have reached	the following learning results		
Students are able to describe methods and calculation	ns for design, modeling, simulation and	l optimization of m	nechatronic systems.
Charles to a second to a secon	deline of more between in contains. The con-		
		an identify, simula	te and design simple
systems and implement those in laboratory conditions	o.		
Students are able to work goal-oriented in small mixe	d groups and present results to target	groups.	
Students are able to recognize and improve knowledge deficits independently.			
With instructor assistance, students are able to evalua	ate their own knowledge level and defi	ne a further course	e of study.
Independent Study Time 124, Study Time in Lecture 5	66		
6			
Written exam			
90 min			
General Engineering Science (German program, 7	semester): Specialisation Mechanic	cal Engineering,	Focus Mechatronics:
Compulsory			
General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Systems
Engineering: Compulsory			
	nester): Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechanical
Engineering: Elective Compulsory			
	semester): Specialisation Mechanic	al Engineering,	Focus Mechatronics:
	semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Systems
	acetor). Consisting Masks -:! 5	incoming Foot: Th	o avatical Macha-!!
	nester): Specialisation Mechanical Eng	meering, Focus Tr	ieoreticai Mechanical
Mechanical Engineering: Specialisation Aircraft System	ne Engineering: Compulsory		
Mechanical Engineering: Specialisation Aircraft System			
Mechanical Engineering: Specialisation Mechatronics:	Compulsory		
	Compulsory echanical Engineering: Compulsory	sorv	
	c Systems (L1822) c Systems (L1823) c Systems (L1824) Prof. Uwe Weltin None Fundatmentals of mechanics, control theory and elect After taking part successfully, students have reached Students are able to describe methods and calculation Students are able to apply modern algorithms for mod Systems and implement those in laboratory conditions Students are able to work goal-oriented in small mixe Students are able to recognize and improve knowledg With instructor assistance, students are able to evalua Independent Study Time 124, Study Time in Lecture 5 SWritten exam Of min General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, 7 Engineering: Elective Compulsory General Engineering Science (English program, 7	c Systems (L1823) Recitation Section (large) c Systems (L1824) Practical Course Prof. Uwe Weltin None Fundatmentals of mechanics, control theory and electrical engineering After taking part successfully, students have reached the following learning results Students are able to describe methods and calculations for design, modeling, simulation and students are able to apply modern algorithms for modeling of mechatronic systems. They consistent are able to work goal-oriented in small mixed groups and present results to target students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and defining endependent Study Time 124, Study Time in Lecture 56 Written exam On min Seneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory	Typ Hrs/wk c Systems (L1822) Lecture 2 c Systems (L1823) Recitation Section (large) 1 c Systems (L1824) Practical Course 1 Practical Course 1 Practical Course 1 Practical Course 1 After taking part successfully, students have reached the following learning results Students are able to describe methods and calculations for design, modeling, simulation and optimization of mostudents are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulations and implement those in laboratory conditions. Students are able to work goal-oriented in small mixed groups and present results to target groups. 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 independent Study Time 124, Study Time in Lecture 56 Written exam Do min General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focunguisory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focungineering: Compulsory

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

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

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

Module M0684: Heat	Transfer			
Courses				
Title Heat Transfer (L0458) Heat Transfer (L0459)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 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	The shudests are able to			
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Tran	sfer,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical w	ay.		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and dev	elop an approach.		
Autonomy	The students are able to develop a complex problem self	f-consistent and analyse the results i	n a critical way. <i>I</i>	qualified exchange
	with other students is given.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale Assignment for the	General Engineering Science (German program, 7 ser	nastar), Enacialization Machanical I	Engineering Fee	us Energy Systems
Following Curricula		nester). Specialisation Mechanical i	ingineering, Foc	us Ellergy Systems.
. onothing curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 semes			
	Engineering: Elective Compulsory			
	Energy Systems: Technical Complementary Course Core			
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical E	Engineering, Foc	us Energy Systems:
	Compulsory General Engineering Science (English program, 7 semest	er): Specialisation Biomedical Engine	ering: Compulso	~v
	General Engineering Science (English program, 7 semest			
	Engineering: Elective Compulsory		-	
	Mechanical Engineering: Specialisation Energy Systems:			
	Mechanical Engineering: Specialisation Theoretical Mechanical	anical Engineering: Elective Compuls	ory	

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

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

Module M0596: Adva	ced Mechanical Design Project
Courses	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Proje	t (L0266) Project-/problem-based Learning 4 6
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
	, tardined inclianted 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.
B	
Personal Competence	After persing the module obudents are able to
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:
Autonomy	Arter passing the module, stadents are able to.
	• independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting
	appropriate methods,
	to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Examination	
Examination duration and	180
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
*	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen
	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanica
	Engineering: Compulsory
	Mechanical Engineering: Core Qualification: Compulsory

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
Content	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.
	Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation
Literature	 Dubbel, Taschenbuch 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 Computer Engineering (L0321)	Typ Hrs/wk CP Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-l programming down to gates. The module includes the following topics:
	 Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the phy composition of computer systems. The students can analyze, how highly specific and individual computers can be built based collection of few and simple components. They are able to distinguish between and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comp system and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to eval
	the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.
Personal Competence	,
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.
Autonomy	stadents are able to acquire new knowledge from specific incratare and to associate and knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and	90 minutes, contents of course and labs
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory
	Compulsory
	Congral Engineering Science (Gorman program 7 competer): Specialisation Mechanical Engineering Focus Riemachan
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developriand Production: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developer and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0833: Intro	duction to Control Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Systems (Li	0654)	Lecture	2	4
Introduction to Control Systems (Li	(655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and from	equency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	Arter taking part successionly, students have reached	the following learning results		
Knowledge				
	Students can represent dynamic system beha	vior in time and frequency domain, and o	an in particular	explain properties of
	first and second order systems			
	 They can explain the dynamics of simple continuous 	of loops and interpret dynamic properties	s in terms of fred	quency response and
	They can explain the Nyquist stability criterion	and the stability margins derived from it		
	They can explain the role of the phase margin			
	They can explain the way a PID controller affect			
	They can explain issues arising when controlle	rs designed in continuous time domain a	e implemented	digitally
CI-III-				
Skills	Students can transform models of linear dynar	nic systems from time to frequency doma	ain and vice vers	a
	They can simulate and assess the behavior of	systems and control loops		
	They can design PID controllers with the help of			
	They can analyze and synthesize simple control			
	They can calculate discrete-time approxim	ations of controllers designed in cont	inuous-time and	d use it for digital
	implementationThey can use standard software tools (Matlab	Control Toolbox Simulink) for carrying or	t these tasks	
	They can use standard software tools (Matida)	control rootsox, simulity, for earlying oc	it these tasks	
Personal Competence				
	Students can work in small groups to jointly solve tec			
Autonomy	Students can obtain information from provided sou when solving given problems.	rces (lecture notes, software documenta	ition, experimen	t guides) and use it
	when solving given problems.			
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	gress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
	Written exam			
Examination duration and scale	120 min			
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Computer Science	6	
Following Curricula				
	General Engineering Science (German program, 7 se			ory
			ering: Compulso	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Naval Architecture	eering: Compulso e: Compulsory	ory
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	mester): Specialisation Naval Architecture mester): Specialisation Civil Engineering:	eering: Compulso e: Compulsory Compulsory	
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	mester): Specialisation Naval Architecture mester): Specialisation Civil Engineering: mester): Specialisation Electrical Enginee mester): Specialisation Biomedical Engine	eering: Compulso e: Compulsory Compulsory ring: Compulsory eering: Compulsory	/ pry
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	co 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
Content	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 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
	Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0725: Produ	uction Engineering			
Courses				
Title Production Engineering I (L0608) Production Engineering I (L0612) Production Engineering II (L0610)		Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	CP 2 1 2
Production Engineering II (L0611)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	no course assessments required internship recommended			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence Knowledge	Students are able to name basic criteria for the selection of mathematic manner and the main groups of Manufacturing Town and the application areas of different manner and boundaries, advantages and disadutes describe elements, geometric properties at explain the essential models of manufacture.	Technology. anufacturing processes. rantages of the different manufacturing pr and kinematic variables and requirements		e and process.
Skills	Students are able to select manufacturing processes in accord design manufacturing processes for simpl assess components in terms of their produces.	le tasks to meet the required tolerances of	f the component to	be produced.
Personal Competence Social Competence	Students are able to • develop solutions in a production environi	ment with qualified personnel at technical	level and represent	t decisions.
Autonomy	Students are able to • interpret independently the manufacturin • assess own strengths and weaknesses in • assess their learning progress and define • assess possible consequences of their ac	general. gaps to be improved.		
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
Scale Assignment for the	Ganaral Engineering Science (Corman programs	7 comoctor): Specialization Machanical F	nginooring Focus T	hoorotical Machanical
Assignment for the Following Curricula		/ semester): specialisation Mechanical E	ngmeening, Focus I	neoreticai Mechanical
. ccimiy carricula	General Engineering Science (German program,	, 7 semester): Specialisation Mechanical I	Engineering, Focus	Product Development
	and Production: Compulsory	•	-	
	General Engineering Science (English program,	7 semester): Specialisation Mechanical En	ngineering, Focus T	heoretical Mechanical
	Engineering: Elective Compulsory General Engineering Science (English program, and Production: Compulsory		Engineering, Focus	Product Development
	Logistics and Mobility: Specialisation Engineering Mechanical Engineering: Core Qualification: Com Mechatronics: Core Qualification: Compulsory			

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

Course L0612: Production Engineering I	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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 Engineering II		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann	
Language	DE	
Cycle	SoSe	
Content	Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005)	
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Hohen, Lappen, 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 Engineering II	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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

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	
Admission Requirements	
Recommended Previous	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematicians
Knowledge	basic MATLAB knowledge
	Julie I I II Julie I I I I I I I I I I I I I I I I I I I
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 finding
	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
Skins	State is the topic to
	implement, apply and compare numerical methods using MATLAB,
	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
	a walk to a though a part of the control of the con
	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.
Washing to Harris	Notice and the State Time 124 State Time is because 55
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Examination	Written exam
Examination duration and	90 minutes
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in
	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Elective Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core Qualification: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
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	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	Engineering: Compulsory
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Computational Science and Engineering: Core Qualification: Compulsory
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory Computational Science and Engineering: Core Qualification: Compulsory

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

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

Module M0854: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Dif	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Dif		Recitation Section (small)	1	1
Differential Equations 2 (Partial Dif	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038) Complex Functions (L1041)		Lecture Recitation Section (small)	2	1
Complex Functions (L1042)		Recitation Section (Iarge)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Charles have a second by the least a second in Mathematical Mathematic	action N/ There are able to combine the		
	Students can name the basic concepts in Mathem Students can discuss legisal connections between			
	 Students can discuss logical connections betwee the help of examples. 	il these concepts. They are capable	or mustrating th	ese connections with
	They know proof strategies and can reproduce the	em.		
	, p			
Skills				
	Students can model problems in Mathematics IV		ed in this course	. Moreover, they are
	capable of solving them by applying established r		nto atualia din tha	
	Students are able to discover and verify further to For a given problem, the students can develop			
	 For a given problem, the students can develop results. 	and execute a suitable approach, a	ind are able to c	ntically evaluate the
	results.			
Personal Competence				
Social Competence				
Social Competence	Students are able to work together in teams. The	y are capable to use mathematics as	a common langu	age.
	In doing so, they can communicate new concepts		perating partners	. Moreover, they can
	design examples to check and deepen the unders	standing of their peers.		
 Autonomy Students are capable of checking their understanding of complex concepts on their own. They can specify open 		ecify open questions		
	precisely and know where to get help in solving the	hem.		
	Students have developed sufficient persistence	to be able to work for longer period	ls in a goal-orien	ted manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points				
Examination				
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equa	tions 2)		
scale				
Assignment for the				
Following Curricula	General Engineering Science (German program, 7 s Compulsory	semester): specialisation Mechanica	ıı Erigineering,	rocus Mechatronics:
	General Engineering Science (German program, 7 seme	ester). Specialisation Mechanical Engin	neering Focus Th	peoretical Mechanical
	Engineering: Compulsory	.s.c.,. specialisation ricchanical Engli	comig, i ocus II	.corected mechanical
	General Engineering Science (German program, 7 seme	ster): Specialisation Naval Architectur	e: Compulsory	
	Computer Science: Specialisation Computational Mather	•		
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanical
	Engineering: Compulsory	ton). Consisting Nov. 1 A. 111	o. Comercia	
	General Engineering Science (English program, 7 semes	•		ulcon.
	Computational Science and Engineering: Specialisation I Computational Science and Engineering: Specialisation (•	iisui y
	Computational Science and Engineering: Specialisation of Computational Science and Engineering: Specialisation I	·	-	
	Mechanical Engineering: Specialisation Theoretical Mech			
	Mechanical Engineering: Specialisation Mechatronics: Co			
	Mechatronics: Core Qualification: Compulsory	•		
	Naval Architecture: Core Qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complem	nentary Course Core Studies: Elective	Compulsory	

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 		
Electatale	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	
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 complex analysis	
Literature	 Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

Course L1041: Complex Functions	
Тур	Recitation Section (small)
Hrs/wk	1
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 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
Management Tutorial (L0882) Introduction to Management (L088	0)	Recitation Section (large) Lecture	2	3
Module Responsible				
Admission Requirements				
-	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important bar and Organisation to Marketing and Innovation, and also to			
	explain the differences between Economics and important definitions from the field of Management explain the most important aspects of and goals i projects describe and explain basic business functions a organization and human ressource management, in explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and select	n Management and name the mos s production, procurement and s formation management, innovation making in Business, esp. in situa mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneur chain manageme nd marketing
Skills	Students are able to analyse business units with respect to out an Entrepreneurship project in a team. In particular, the		ojectives, strateg	ies etc.) and to ca
	 analyse Management goals and structure them app analyse organisational and staff structures of comp apply methods for decision making under multiple analyse production and procurement systems and f analyse and apply basic methods of marketing select and apply basic methods from mathematical apply basic methods from accounting, costing and of 	anies Objectives, under uncertainty and un Business information systems finance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an ent to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselve to write a report on their project.		oherent report or	the project
	to write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Subject theoretical and practical work			
	several written exams during the semester			
scale				
	General Engineering Science (German program, 7 semesti	er): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula		er): Specialisation Process Engineer er): Specialisation Biomedical Engin	ing: Compulsory eering: Compulso	
	General Engineering Science (German program, 7 semesti General Engineering Science (German program, 7 semesti General Engineering Science (German program, 7 semesti	er): Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semesti General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se Compulsory	er): Specialisation Energy and Envir	omental Enginee	
	General Engineering Science (German program, 7 sec Compulsory			
	General Engineering Science (German program, 7 sem Engineering: Compulsory General Engineering Science (German program, 7 se	•		
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory		-	
	General Engineering Science (German program, 7 semes and Production: Compulsory General Engineering Science (German program, 7 sem	_		

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory
Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload	Independent Study Time 62, Study Time in Lecture 28		
in Hours			

Lecturer Prof. Christoph Ihl. Katharina Roedelius. Tobias Vlcek

Language DE

Cycle WiSe/SoSe

Course L0882: Management Tutorial

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 so selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

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.

Module M0933: Funda	amentals of Materials Science			
Courses				
Title Fundamentals of Materials Science	l (L1085) Il (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Typ Lecture Lecture	Hrs/wk 2 2	CP 2 2
Physical and Chemical Basics of Ma	· · · · · · · · · · · · · · · · · · ·	Lecture	2	2
Module Responsible				
Admission Requirements	None			
	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 a comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. T for materials and can identify relevant approaches for chaphenomena back to the underlying physical and chemical laws	cally the issues of ator he students know abo aracterizing specific p	nic structure, microstructu ut the key aspects of char	ire, phase diagrams, acterization methods
Skills	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as strength resistance, and to phase transformations such as solidification between processing conditions and the materials microstruct material's behavior.	ngth, ductility, and st	iffness, chemical propertion nelting. The students can	es such as corrosion explain the relation
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisation	Energy and Envirome	ental Engineering: Compul	sory
Following Curricula				
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S	•		ry
	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	•		ing Compulsory
	Energy and Environmental Engineering: Core Qualification: Cor	. 3,	ina Environientai Engineer	ing: Compulsory
	General Engineering Science (English program): Specialisation		ntal Engineering: Compuls	orv
	General Engineering Science (English program): Specialisation			0.,
	General Engineering Science (English program): Specialisation	_		
	General Engineering Science (English program): Specialisation	Naval Architecture: Co	ompulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanic	al Engineering: Compulsor	ry .
	General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedic	al Engineering: Compulsor	У
	General Engineering Science (English program, 7 semester): Sp	pecialisation Naval Arc	hitecture: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	pecialisation Energy ar	nd Enviromental Engineeri	ng: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elec	tive Compulsory		
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	octivo Compulsor		
	Technomathematics: Specialisation III. Engineering Science: Ele	scuve compulsory		

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

Course L0506: Fundamentals	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 I 1005 - Physical and a	Character I Bendan of Matarial a Catanan
	Chemical Basics of Materials Science
	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	 Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	Für den Elektromagnetismus: • Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter Für die Atomphysik: • Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: • Hornbogen, Warlimont: "Metallkunde", Springer

Module M0730: Comp	outer Engineering			
Courses				
Title	_	Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)	To 6 11 11 5 11	Recitation Section (small)	1	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge				
	The successful completion of the labs will be honored di rules:	uring the evaluation of the module's e	xamination acco	rding to the following
	1 Union a grand mandale according to the about on	to according to the control of the control of the		
	Upon a passed module examination, the student such that the examination's marks are lifted by 0	y .		the successiul labs
	2. The improvement of the grade 5,0 up to 4,3 and		better grader	
Educational Objections	After the Life or an extra constitution of the	a fallando o la conto o casadea		
Educational Objectives Professional Competence		le following learning results		
•	This module deals with the foundations of the function	nality of computing systems. It cover	s the lavers from	n the assembly-leve
	programming down to gates. The module includes the f		,	,
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean	olean functions, hardware synthesis, c	ombinational net	works
	Sequential logic: Flip-flops, automata, systematic	•		
	Technological foundations			
	Computer arithmetic: Integer addition, subtraction			
	Basics of computer architecture: Programming m Manager Manager History rehice CRAM DRAM and		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, cad Input/output: I/O from the perspective of the CPU		oint connections	. busses
Skills	The students perceive computer systems from the arch			
	composition of computer systems. The students can an collection of few and simple components. They are abl			
	today's computing systems - from gates and circuits up		ann and annorone	assuraction layers o
	After successful completion of the module, the studen	ate are able to judge the interdenend	oncios hotwoon	a physical compute
	system and the software executed on it. In particular, t			
	on the hardware-centric abstraction layers from the ass	·		
	the impact that these low abstraction levels have on an	entire system's performance and to \mathfrak{p}	ropose feasible	options.
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a	a group and to present the results acc	ordingly.	
Autonomy	Students are able to acquire new knowledge from speci	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				
	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the	General Engineering Science (German program): Core C	Qualification: Compulsory		
Following Curricula			. ,	
	General Engineering Science (German program, 7 seme			ory
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme	•		
	General Engineering Science (German program, 7 seme	. ,	. ,	у
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme	ester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering,	Focus Mechatronics
	Compulsory General Engineering Science (German program, 7	comester). Specialisation Mechanica	I Engineering I	ocus Riomechanics
	Compulsory	semester). Specialisation Methallica	. Luguicelliy, I	ocus biomechanics
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory	octor). Specialisation Machanical Francisco	pooring Forms T	poorotical Machani-
	General Engineering Science (German program, 7 seme Engineering: Compulsory	ester): specialisation Mechanical Engli	ieering, Focus Th	ieoreticai Mechanica
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Eng	ineering, Focus I	Product Developmen
	and Production: Compulsory		<u>.</u>	
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical	Engineering, Foo	us Energy Systems
	Compulsory			
	Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Core Qualification.	ualification: Compulsory		
	J J J J J J J J J J J J J J J J J J J			

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

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

Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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 and such	toms. Cood knowledge in maths	s covered by the	a module Mathematik
	The modul is an introduction to the theory of signals and syst			
	1-3 is expected. Further experience with spectral transform but not required.	ations (Fourier Series, Fourier tra	пѕютт, саріасе	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and li	near time-invariant (LTI) systems	using methods	of signal and system
	theory. They are able to apply the fundamental transformat	ions of continuous-time and disc	rete-time signals	and systems. They
	can describe and analyse deterministic signals and systems	s mathematically in both time ar	nd image domai	n. In particular, they
	understand the effects in time domain and image domain	which are caused by the transit	ion of a continu	ous-time signal to a
	discrete-time signal.			
Skills	The students are able to describe and analyse deterministic	signals and linear time-invariant	systems using m	ethods of signal and
	system theory. They can analyse and design basic syste	ms regarding important propert	ies such as ma	agnitude and phase
	response, stability, linearity etc They can assess the impact	of LTI systems on the signal prop	erties in time ar	nd frequency domain.
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information fr	om appropriate literature sourc	es. They can c	ontrol their level of
	knowledge during the lecture period by solving tutorial proble	ems, software tools, clicker system	m.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisation	on Electrical Engineering: Compu	lsory	
Following Curricula	General Engineering Science (German program): Specialisation	on Computer Science: Compulsor	у	
	General Engineering Science (German program): Specialisati	on Process Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisati	on Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (German program): Specialisati	on Civil- and Enviromental Engen	eering: Compuls	ory
	General Engineering Science (German program): Specialisati	on Mechanical Engineering: Comp	oulsory	
	General Engineering Science (German program): Specialisati			
	General Engineering Science (German program, 7 semester):			/
	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semester):			
	General Engineering Science (German program, 7 semester):			-
	General Engineering Science (German program, 7 semester):			-
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineering, F	ocus Biomechanics:
	Compulsory	van). Cassislination Machanias I	animanian Fac	us Energy Cychenes
	General Engineering Science (German program, 7 semest Compulsory	er): Specialisation Mechanical E	ingineering, Foc	us Energy Systems:
	General Engineering Science (German program, 7 semest	tor). Specialisation Mechanical F	nainoorina Eoo	us Aircraft Systoms
	Engineering: Compulsory	ter). Specialisation Mechanical i	ingineering, roc	us Aircraft Systems
	General Engineering Science (German program, 7 sem	ester). Specialisation Mechanic	al Engineering	Focus Materials in
	Engineering Sciences: Compulsory	, openingunon ricciallic	Luginceinig,	. seas materials ill
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanica	Engineering,	Focus Mechatronics:
	Compulsory	,		
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisatio	n Civil- and Enviromental Engene	ering: Compulso	ry
	General Engineering Science (English program): Specialisatio	n Bioprocess Engineering: Compu	ılsory	
	General Engineering Science (English program): Specialisatio	n Electrical Engineering: Compuls	sory	
	General Engineering Science (English program): Specialisation	n Computer Science: Compulsory	,	
	General Engineering Science (English program): Specialisation	n Mechanical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisation	n Biomedical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisation	n Process Engineering: Compulso	ry	
	General Engineering Science (English program, 7 semester):	Specialisation Electrical Engineer	ing: Compulsory	
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):	· -		
	General Engineering Science (English program, 7 semester):			-
	General Engineering Science (English program, 7 semester):			-
	General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical	Engineering, F	ocus Biomechanics:
	Compulsory			- F 6 :
	General Engineering Science (English program, 7 semest	er): Specialisation Mechanical E	ngineering, Foc	us Energy Systems:

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Courses				
Title Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
	Prof. Thomas Rung			
-	None			
Recommended Previous ! Knowledge	Sound knowledge of engineering mathematics, engineering	mechanics and thermodynamics.		
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
!	Students will have the required sound knowledge to expl Students can scientifically outline the rationale of flow phy performance analysis and the prediciton of fluid engineering Students are able to apply fluid-engineering principles and	sics using mathematical models a g devices.	and are familiar v	vith methods for the
3	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lectur enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on scientific level.			
Personal Competence Social Competence	The students are able to discuss problems and jointly develop solution strategies.			
Autonomy ⁻	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program): Specialisat	tion Mechanical Engineering: Com	pulsory	
Following Curricula	General Engineering Science (German program): Specialisat	tion Biomedical Engineering: Com	pulsory	
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester	· ·		-
	General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester			ry
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engine	eering: Compulsor	у
	General Engineering Science (English program, 7 semester)			
	Computational Science and Engineering: Specialisation Engi	neering Sciences: Elective Compu	ılsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

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

Course L0455: Fluid 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		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0960: Mech	anics IV (Kinetics II, Oscillations, Analy	ytical Mechanics, Multibo	dy Systems)	
Courses					
Title		Тур	Hrs/wk	СР	
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3	
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2	
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous	Mathematics I-III and Mechanics I-III				
Knowledge					
Educational Objectives	After taking part successfully, students have reached th	e following learning results			
Professional Competence					
Knowledae	The students can				
3					
	 describe the axiomatic procedure used in mechan 	nical contexts;			
	 explain important steps in model design; 				
	 present technical knowledge. 				
Skills	The students can				
S.M.S	The Stadents can				
	explain the important elements of mathematical	/ mechanical analysis and model form	nation, and appl	y it to the context of	
	their own problems;				
	 apply basic methods to engineering problems; 				
	 estimate the reach and boundaries of the method 	ls and extend them to be applicable to	wider problem	sets.	
,	The students can work in groups and support each other Students are capable of determining their own strengths		ir time and learn	ing based on those.	
	Independent Study Time 96, Study Time in Lecture 84				
Credit points					
Examination					
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program): Specia	lisation Mechanical Engineering: Com	oulsory		
Following Curricula	General Engineering Science (German program): Specia	lisation Biomedical Engineering: Com	oulsory		
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engin	eering: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (German program, 7 seme	ster): Specialisation Naval Architectur	e: Compulsory		
	General Engineering Science (English program): Speciali	sation Mechanical Engineering: Comp	ulsory		
	General Engineering Science (English program): Special	sation Biomedical Engineering: Comp	ulsory		
	General Engineering Science (English program): Speciali				
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engine	ering: Compulso	ry	
	General Engineering Science (English program, 7 semes	· ·		ry	
	General Engineering Science (English program, 7 semes	•	: Compulsory		
	Mechanical Engineering: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Scien	nce: Elective Compulsory			
	1	entary Course Core Studies: Elective			

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

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

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

Module M1277: MED I	l: 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	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeletal system.			
	The students can describe the basic macroscopy and microscopy of those systems.			
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; the			
S.M.S	can explain the relevance of structures and their functions in the context of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.			
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquir			
,	the relevant knowledge themselves.			
	Independent Study Time 62, Study Time in Lecture 28			
Credit points				
Examination				
Examination duration and	90 minutes			
scale				
Assignment for the				
Following Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics			
	Compulsory			
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory			
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic			
	Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory			
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Course L0384: Introduction t	o Anatomy	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study	Time 62, Study Time in Lecture 28
	Prof. Tobias Lange	
Language		
Cycle		
Content	General Anatomy	y
	1 st week:	The Eucaryote Cell
	nd.	
	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/Michae	el Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012

Courses					
itle					
	ation Thorsey (L0202)	Typ Lecture	Hrs/wk CP		
stroduction to Radiology and Radi		Lecture	2 3		
Admission Requirements					
Recommended Previous	None				
Knowledge	After teline were acceptable at all and a re-	sala ad the fallowing language was the			
Educational Objectives Professional Competence	After taking part successfully, students have rea	acried the following learning results			
Knowledge	Therapy The students can distinguish different types of o	surrently used equipment with respect	to its use in radiation therapy.		
	The students can explain treatment plans used	in radiation therapy in interdisciplinary	contexts (e.g. surgery, internal medicine).		
	The students can describe the patients' pa	ssage from their initial admittance	through to follow-up care.		
	Diagnostics	-			
	The students can illustrate the technical base well as sectional imaging techniques (CT, MRT,		cluding angiography and mammography,		
	The students can explain the diagnostic as well techniques.		ques, as well as the technical basis for tho		
	The students can choose the right treatment me	ethod depending on the patient's clinic	al history and needs.		
	The student can explain the influence of technic		•		
Skills	The student can draw the right conclusions base Therapy	ed on the images' diagnostic findings o	r the error protocol.		
	The students can distinguish curative and palliative situations and motivate why they came to that conclusion.				
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.				
	The students can use the therapeutic principle (effects vs adverse effects)				
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).				
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).				
	Diagnostics				
	The students can suggest solutions for repairs o	f imaging instrumentation after having	done error analyses.		
			•		
	The students can classify results of imaging to anatomy, pathology and pathophysiology.	echniques according to uniferent group	of diseases based on their knowledge		
Personal Competence	The students can assess the special social situa	tion of tumor natients and interact with	them in a professional way		
Social competence	The students are aware of the special, often measures and can meet them appropriately.				
Autonomy	The students can apply their new knowledge an The students can introduce younger students to				
	The students are able to access anatomical known and acquire the relevant knowledge themselves		e competently in conversations on the top		
Workload in Hours	Independent Study Time 62, Study Time in Lect	ure 28			
Credit points					
Examination	Written exam				
Examination duration and scale	90 minutes				
Assignment for the	General Engineering Science (German program)	: Specialisation Mechanical Engineering	g, Focus Biomechanics: Compulsory		
Following Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (German program, General Engineering Science (German progra Compulsory				
	Electrical Engineering: Specialisation Medical Te	chnology: Elective Compulsory			
	General Engineering Science (English program):	Specialisation Mechanical Engineering	·		
	General Engineering Science (English program):				
	General Engineering Science (English progra	iii, / semester). specialisation Mec	mamear Engineering, rocus Biomechanic		
	Compulsory				
	General Engineering Science (English program,	•	Engineering: Compulsory		
		anics: Compulsory			

Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Trible Tr	Module M0598: Mech	anical Engineering: Design			
Fire incomment Design and 3D-CAD (1,0288) Fire incomment Design and 3D-CAD (1,0288) Fire incomment Design and 3D-CAD (1,0288) Fire incomment Design and 3D-CAD (1,0288) From Project Design Methodology (1,0267) Module Responsibile Recommended Previous Recommended Previous Fire incommended Previous Fire incomme	Courses				
inhodinent Design and 3P.CAD (10:28) Lecture 2 1 chancial Design Project (10:695) P			Typ	Hrs/wk	CP
Project Competence Project Competence Project Competence Project Proje		_0268)			_
Module Responsible Prof. Dieter Krouse					
Module Responsible Adminssion Requirements None Recommended Previous Knowledge Fundamentals of Methanical Engineering Design Methanics Production Engineering Production Production Engineering Production Production Engineering Production Production Engineering Production Production Engineering Production Production Engineering Production Production Engineering Production Production Production Engineering Production Production Production Production Production Production Production Production Production Production Production Production Production Production Production Production Production P	Mechanical Design Project II (L0592	2)	Project-/problem-based Learning	3	2
Recommended Previous Knowledge Fundamentals of Mechanical Engineering Design Fundamentals of Mechanics Fundamentals of Methanics Fundamentals of Methani	Team Project Design Methodology	(L0267)	Project-/problem-based Learning	2	1
Recommended Previous Knowledge Fundamentals of Mechanics Fundamentals of Mechanics Fundamentals of Materials Science Froduction Engineering Educational Objectives After taking part successfully, students have reached the following learning results After passing the module, students are able to: Explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, describe basics of 30 CAD, explain basics methods of engineering designing. Skills After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. Personal Competence Social Competence After passing the module, students are able to: develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. Autonomy Students are able to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), reflect the own results in the work groups of the course. To solve engineering design tasks systematically. Workload in Hours Credit points Examination Written exam Examination duration and scale Assignment for the Following Curricula Following Curricula General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineeri	Module Responsible	Prof. Dieter Krause			
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Mechatronics: Core Qualification: Compulsory		Mechatronics: Core Qualification: Compulsory			
Naval Architecture: Core Qualification: Compulsory		Naval Architecture: Core Qualification: Compulsory			

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

	erical Mathematics I			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
	Prof. Sabine Le Borne			
Admission Requirements				
Recommended Previous Knowledge	Mathematik I + II for Engineering Students (german)	n or english) or Analysis & Linear Alg	gebra I + II for Te	echnomathematicians
	basic MATLAB knowledge			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence	r			
Knowledge	Students are able to			
	name numerical methods for interpolation, integrate	tion, least squares problems, eigenv	/alue problems, r	nonlinear root finding
	problems and to explain their core ideas,			
	repeat convergence statements for the numerical r			
	explain aspects for the practical execution of nume	rical methods with respect to comp	utational and sto	rage complexitx.
Skille	5 Students are able to			
SKIIIS	Students are able to			
	implement, apply and compare numerical methods			
	justify the convergence behaviour of numerical met called and everythe a suitable calleting approach for	·	nd solution algori	ithm,
	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	s (i.e., teams from different study p	rograms and bac	kground knowledge),
	explain theoretical foundations and support each of			
Autonomy	Students are capable			
Autonomy	Students are capable			
	to assess whether the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the supporting theoretical and process the support of t		individually or in	n a team,
	 to assess their individual progess and, if necessary, 	, to ask questions and seek help.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
	Written exam			
Examination duration and				
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Assignment for the	General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic General Engineering Science (German program, 7 semestic Engineering: Elective Compulsory General Engineering Science (German program, 7 semestic Engineering: Compulsory General Engineering: Specialisation A - General Bioproc Computer Science: Specialisation Computational Mathematic Electrical Engineering: Core Qualification: Elective Compul General Engineering Science (English program, 7 semestic General Engineering Science (English program, 7 semestic General Engineering Science (English program, 7 semestic General Engineering Science (English program, 7 semestic General Engineering Science (English program, 7 semestic General Engineering Science (English program, 7 semestic Engineering: Compulsory General Engineering Science (English program, 7 semestic Engineering: Compulsory General Engineering Science (English program, 7 semestic Engineering: Elective Compulsory Computational Science and Engineering: Core Qualificatio Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Engineering: Specialisation Theoretical Mechanical Engineering: Special	emester): Specialisation Mechanical er): Specialisation Biomedical Engin mester): Specialisation Mechanical Enginer): Specialisation Mechanical Enginer): Specialisation Mechanical Enginer): Specialisation Mechanical Enginerers: Elective Compulsory (Specialisation Computer Science (Er): Specialisation Mechanical Enginerer): Specialisation Mechanical Enginerer	eering: Compulsor Deering, Focus Theering, Focus Theering, Focus Theering, Focus Theering, Focus Malering: Compulsor Deering: C	pry Focus Biomechanics: neoretical Mechanical neoretical Mechanical terials in Engineering ry Focus Biomechanics: neoretical Mechanical

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

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

Module M0684: Heat	Transfer			
Courses				
Title Heat Transfer (L0458) Heat Transfer (L0459)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Dr. Andreas Moschallski	<u> </u>		
Admission Requirements	None			
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfe	er,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way	′ .		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develo	p an approach.		
Autonomy	The students are able to develop a complex problem self-co	onsistent and analyse the results i	n a critical way. A	qualified exchange
	with other students is given.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German program, 7 semes	ster): Specialisation Mechanical I	Engineering, Focu	us Energy Systems:
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engine	eering: Compulso	ry
	General Engineering Science (German program, 7 semester	r): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanical
	Engineering: Elective Compulsory Energy Systems: Technical Complementary Course Core Stu	idiosi Flastiva Compulsory		
	General Engineering Science (English program, 7 semes	, ,	Engineering, Focu	ıs Energy Systems:
	Compulsory		Jg, . occ	5, 2,222.78.
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engine	ering: Compulsor	у
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering, Focus The	eoretical Mechanical
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation Energy Systems: Co Mechanical Engineering: Specialisation Theoretical Mechani		orv	
	Prechanical Engineering. Specialisation Theoretical Mechani	car Engineering. Elective Compuls	O. 3	

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

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

Module M0956: Measu	rement Technology for Mechanical	and Process Engineers		
Courses				
Title Practical Course: Measurement and Control Systems (L1119) Measurement Technology for Mechanical and Process Engineers (L1116)		Typ Practical Course Lecture	Hrs/wk 2 2	CP 2 3
Measurement Technology for Mechanical and Process Engineers (L1118) Recitation Section (large)		1	1	
Module Responsible				
	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical	engineering		
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
-	Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncertain Calibration, Static and Dynamic Properties of Sensors and Systems).			d Units, Uncertainty
	They can outline the most important measuring me Temperature, mechanical quantities, Flow, Time, Fre	•	to be maesured (Electrical Quantities
	They can describe important methods of chemical Ar	nalysis (Gas Sensors, Spectroscopy, Gas	Chromatography)	
Skills	Students can select suitable measuring methods to g	liven problems and can use refering me	asurement device	s in practice.
	The students are able to orally explain issues in the place the issues into the right context and application		gy and solution a	oproaches as well a
Personal Competence Social Competence	Students can arrive at work results in groups and document them in a common report.			
Autonomy	Students are able to familiarize themselves with new	measurement technologies.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and	105 minutes			
scale				
-	General Engineering Science (German program, 7 se		-	
_	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 ser		neering: Compulso	ory
	Energy and Environmental Engineering: Core Qualific General Engineering Science (English program, 7 sen		omental Engineer	na: Compulsory
	General Engineering Science (English program, 7 sen			
	General Engineering Science (English program, 7 sen			•
	Mechanical Engineering: Core Qualification: Compuls	- · ·		,
	Mechatronics: Core Qualification: Compulsory	•		
	Process Engineering: Core Qualification: Compulsory			

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

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

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

Module M1279: MED II	: Introduction to Biochemis	try and Molecular Biology		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and Mo	lecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	 explain how genetic information is 	coded in the DNA;		
	explain the connection between Di			
		•		
Skills	The students can			
	recognize the importance of molection	cular parameters for the course of a disease;		
	describe selected molecular-diagnorm	ostic procedures;		
	explain the relevance of these pro-	cedures for some diseases		
Personal Competence				
•	The students can participate in discussion	ns in research and medicine on a technical level.		
· ·	, ,			
Autonomy	The students can develop understanding	of topics from the course, using technical literat	ture, by themselves.	
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Biomedical E	ngineering: Compulso	ry
_		program, 7 semester): Specialisation Mecha	nical Engineering, F	ocus Biomechanics:
	Compulsory			
	Electrical Engineering: Specialisation Med			
		program, 7 semester): Specialisation Mecha	nical Engineering, Fo	ocus Biomechanics:
	Compulsory	anna 7 annacharl Canadaliantian Diamadian Fu	ainaarina. Caranulaar	
	General Engineering Science (English pro Mechanical Engineering: Specialisation B	ogram, 7 semester): Specialisation Biomedical En	igineering: Compuisor	у
		anagement and Business Administration: Electiv	re Compulsory	
		rtificial Organs and Regenerative Medicine: Elect		
		edical Technology and Control Theory: Elective (
		nplants and Endoprostheses: Elective Compulsor		
	3 3			

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

	duction to Control Systems
Courses	
Title	Typ Hrs/wk CP 0654) Lecture 2 4
Introduction to Control Systems (LC Introduction to Control Systems (LC	
Module Responsible	
Admission Requirements	
-	Representation of signals and systems in time and frequency domain, Laplace transform
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	Arter taking part successibility, students have reached the following learning results
Knowledge	
, and the second	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties
	first and second order systems Thou can explain the dynamics of simple central loops and interpret dynamic proporties in terms of frequency response.
	 They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response are root locus
	They can explain the Nyquist stability criterion and the stability margins derived from it.
	They can explain the role of the phase margin in analysis and synthesis of control loops
	They can explain the way a PID controller affects a control loop in terms of its frequency response
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	
Skins	Students can transform models of linear dynamic systems from time to frequency domain and vice versa
	They can simulate and assess the behavior of systems and control loops
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can produce and supthesize simple control learns with the help of reach leave and frequency response to the investor
	 They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for dig
	implementation
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	Chudanta ang wall in amall avayon to isinth, and a hoshaidal avalabana and avanimontally validate their controller designs
	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and us when solving given problems.
	When solving given problems.
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	
Credit points	
Credit points	6 Written exam
Credit points Examination Examination duration and scale	6 Written exam 120 min
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Credit points Examination Examination duration and scale Assignment for the	Written exam 120 min General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
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General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core Qualification: Compulsory

Course L0654: Introduction t	co 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 Computes based assertions throughout the course.
	Computer-based exercises throughout the course
Literature	Worner H. Lecture Notes: Introduction to Control Systems
	Werner, H., Lecture Notes "Introduction to Control Systems" C.E. Eranklin, J.D. Bouvell and A. Emami Nacini "Engelback Control of Dynamic Systems", Addison Wooley, Boading, MA. 2000.
	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, Proptice Hall, Upper Saddle Biver, NJ, 2010.
	 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
	- N.C. Don and N.H. Dishop, Prodein Control Systems, Addison Wesley, Reduling, MA 2010

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1333: BIO I:	: Implants and Fracture Healing	
Courses		
Title Implants and Fracture Healing (L03)	27	CP 3
Module Responsible	Prof. Michael Morlock	
Admission Requirements	None	
Recommended Previous	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence.	
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.	
Skills	The students can determine the forces acting within the human body under quasi-static situations under specific a	ssumptions.
Personal Competence		
Social Competence	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.	
Autonomy	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Examination	Written exam	
Examination duration and	90 min	
scale		
_	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus	s Biomechanics:
Following Curricula		
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus	s Biomechanics:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsory	
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory	
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory	
	Orientierungsstudium: Core Qualification: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

TitleTypHrs/wkCPManagement Tutorial (L0882)Recitation Section (large)23					
Newton Responsible 1	Courses				
Medular Repressible No. Christopoli II Admission Requirements Accumenanted Providure Excumenanted Providure Excuration Accommendate Education Accommendate Accommend	Title		**		
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Professional Competence Knowledge Are taking this module, students know the important basics of many different areas in Business and Management, from Ri and Organisation to Marketing and Innovation, and also to investment and Controlling. In particular they are able to capital the differences between Economics and Management and the sub-disciplines in Management and controlling. In particular they are able to capital the most important aspects of and goals in Management and name the most important aspects of entrept projects describe and explain beautiful production and goals in Management and name the most important aspects of entrept projects describe and explain the relevance of planning and decision making in Business, esp. in situations under multiple objective uncertainty, and explain some basic methods for mathematical finance estate basics from accounting and cesting and selected controlling methods. Solido Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to an Entrepreneurship project in a term. In particular, they are able to analyse romakendamical and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyses organizational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyses organizational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyses and apply basic methods of marketing select and apply basic methods of marketing select and apply basic methods of marketing select and apply basic methods of marketing select and apply basic methods from accounting, costing and controlling to predefined problems apply basic methods from accounting, costing and controlling to predefined problems apply basic methods from the lecture to an entrepreneurship project and write a cohere					
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out an Entrepreneurship project in a team. In particular, they are able to • analyse Management gools and structure them appropriately • analyse production and procurement systems and Business information systems • analyse production and procurement systems and Business information systems • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • sapply basic methods from accounting, costing and controlling to predefined problems • work successfully in a team of students • to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project • to communicate appropriately and • to cooperate respectfully with their fellow students. **Autonomy** Students are able to • work in a team and to organize the team themselves • to write a report on their project. Workload in Hours* Morkload in Hours* Independent Study Time 110, Study Time in Lecture 70 Credit points 6 Examination duration and several written exams during the semester Scale Assignment for the General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mehal General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mehal Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mehal Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Morter Engineering Science (German prog		 important definitions from the field of Manageme explain the most important aspects of and goal projects describe and explain basic business functions organization and human ressource management, explain the relevance of planning and decisio uncertainty, and explain some basic methods fro 	as in Management and name the mos as production, procurement and so information management, innovation in making in Business, esp. in situal m mathematical Finance	t important aspe ourcing, supply management ar	cts of entreprneu chain manageme nd marketing
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Social Competence work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Autonomy Students are able to work in a team and to organize the team themselves to write a report on their project. Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points Examination Subject theoretical and practical work Examination duration and scale Assignment for the Following Curricula General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecl Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecl Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecl Engineering: Compulsory Gene		analyse organisational and staff structures of cor apply methods for decision making under multipl analyse production and procurement systems an analyse and apply basic methods of marketing select and apply basic methods from mathematic	npanies e objectives, under uncertainty and und d Business information systems cal finance to predefined problems	nder risk	
work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. *** ***Autonomy** Students are able to work in a team and to organize the team themselves to write a report on their project. ***Workload in Hours** Independent Study Time 110, Study Time in Lecture 70 ***Credit points** Examination Subject theoretical and practical work Examination duration and several written exams during the semester scale Assignment for the General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Diputer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sy Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechat Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechat Engineering: Co	•				
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Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course L0882: Management Tutorial

Typ Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

Cvcle

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 business idea from the point of view of an established company or a startup. knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Module M0634: Introduction into Medical Technology and Systems				
Courses				
Title		Тур	Hrs/wk	СР
Introduction into Medical Technolog	gy and Systems (L0342)	Lecture	2	3
Introduction into Medical Technolog	gy and Systems (L0343)	Project Seminar	2	2
Introduction into Medical Technolog	gy and Systems (L1876)	Recitation Section (large	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous	principles of math (algebra, analysis/calculus)			
Knowledge	principles of stochastics			
	principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	The students can explain principles of medica	technology, including imaging system	ns, computer aided s	surgery, and medical
	information systems. They are able to give an ov	erview of regulatory affairs and standar	ds in medical technol	ogy.
Skills	The students are able to evaluate systems and n	nedical devices in the context of clinical	applications.	
Personal Competence				
Social Competence	The students describe a problem in medical tech	nology as a project, and define tasks th	at are solved in a join	t effort.
Autonomy	The students can reflect their knowledge and de	ocument the results of their work. They	can present the resi	ults in an appropriate
	manner.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	cure 70		
Credit points	6			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Biomedical I	Engineering: Compuls	ory
Following Curricula	Computer Science: Specialisation Computer and	Software Engineering: Elective Compuls	sory	
	Electrical Engineering: Core Qualification: Electiv	e Compulsory		
	General Engineering Science (English program, 7	semester): Specialisation Biomedical E	ngineering: Compulso	ory
	Computational Science and Engineering: Special	sation II. Mathematics & Engineering Sc	ience: Elective Comp	ulsory
	Computational Science and Engineering: Special	sation Computer Science: Elective Com	pulsory	
	Computational Science and Engineering: Special	sation Engineering Sciences: Elective C	ompulsory	
	Biomedical Engineering: Specialisation Artificial (Organs and Regenerative Medicine: Elec	tive Compulsory	
	Biomedical Engineering: Specialisation Implants	and Endoprostheses: Elective Compulso	ry	
	Biomedical Engineering: Specialisation Medical T	echnology and Control Theory: Elective	Compulsory	
	Biomedical Engineering: Specialisation Managem	ent and Business Administration: Electi	ve Compulsory	
	Technomathematics: Specialisation III. Engineeri	ng Science: Elective Compulsory		

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

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

Course L1876: Introduction i	nto Medical Technology and Systems
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe SoSe
Content	- imaging systems
	- computer aided surgery
	- medical sensor systems
	- medical information systems
	- regulatory affairs
	- standard in medical technology
	The students will work in groups to apply the methods introduced during the lecture using problem based learning.
Literature	Wird in der Veranstaltung bekannt gegeben.

Module M1280: MED	II: Introduction to Physiology
Courses	
Title	Typ Hrs/wk CP
Introduction to Physiology (L0385)	Lecture 2 3
Module Responsible	Dr. Roger Zimmermann
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can
	describe the basics of the energy metabolism;
	 describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensory physiology.
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing of information, development
	of forces and 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, t
	themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and	60 minutes
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic
	Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanic
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Medical recliniology and Control Theory: 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 t	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, Dr. Roger Zimmermann	
Language	DE	
Cycle	SoSe	
Content		
Literature	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme	
	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier	

Module M1332: BIO I:	Experimental Methods in Biomechanics
Courses	
Title Experimental Methods in Biomecha	Typ Hrs/wk CP anics (L0377) Lecture 2 3
Module Responsible	
Admission Requirements	
•	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".
	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence. The students can name different treatments for the spine and hollow bones under given fracture morphologies. 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	The students can, in groups, solve basic experimental tasks.
Autonomy	The students can, in groups, solve basic experimental tasks.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Examination	Written exam
Examination duration and	90 min
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics
Following Curricula	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Specialization Naval Architecture

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.

	luction to Control Systems			
ourses				
itle		Тур	Hrs/wk	CP
troduction to Control Systems (L0		Lecture	2	4
troduction to Control Systems (L0	(655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and	frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	ned the following learning results		
Professional Competence				
Knowledge				
	Students can represent dynamic system be	chavior in time and frequency domain, and o	an in particular	explain properties
	first and second order systems			
	They can explain the dynamics of simple contains	ontrol loops and interpret dynamic properties	s in terms of frec	luency response a
	root locus			
	They can explain the Nyquist stability criter	· -		
	They can explain the role of the phase man			
	They can explain the way a PID controller a			P 25 H
	They can explain issues arising when contri-	ollers designed in continuous time domain ai	re implemented (digitally
Skills				
	 Students can transform models of linear dy 	namic systems from time to frequency doma	ain and vice vers	a
	 They can simulate and assess the behavior 	of systems and control loops		
	 They can design PID controllers with the he 	Ip of heuristic (Ziegler-Nichols) tuning rules		
	 They can analyze and synthesize simple co 	ntrol loops with the help of root locus and fre	equency respons	e techniques
	 They can calculate discrete-time approx 	timations of controllers designed in cont	inuous-time and	d use it for digi
ļ	implementation			
	 They can use standard software tools (Matl 	ab Control Toolbox, Simulink) for carrying ou	it these tasks	
Personal Competence				
Social Competence	- ' '			
Autonomy	Students can obtain information from provided	sources (lecture notes, software documenta	ation, experimen	t guides) and use
	when solving given problems.			
ļ	They can assess their knowledge in weekly on-line	tests and thereby control their learning pro	arocc	
			gress.	
			gress.	
		,	gress.	
		, , , , , , , , , , , , , , , , , , , ,	gress.	
Workload in Hours	Independent Study Time 124. Study Time in Lectu		gress.	
	Independent Study Time 124, Study Time in Lectu		yress.	
Credit points	6		yi ess.	
	6		yl ess.	
Credit points	6 Written exam		yl ess.	
Credit points Examination	6 Written exam		yl ess.	
Credit points Examination Examination duration and scale	6 Written exam	re 56	yl ess.	
Credit points Examination Examination duration and scale	6 Written exam 120 min	re 56 Core Qualification: Compulsory		
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program):	core Qualification: Compulsory semester): Specialisation Computer Science	e: Compulsory	ry
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine	e: Compulsory eering: Compulso	ry
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture	e: Compulsory eering: Compulso e: Compulsory	ry
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering:	e: Compulsory eering: Compulso e: Compulsory Compulsory	
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering: semester): Specialisation Electrical Enginee	e: Compulsory eering: Compulso e: Compulsory Compulsory ring: Compulsory	,
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Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering: semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Biomedical Engine	e: Compulsory eering: Compulsory Compulsory ring: Compulsory eering: Compulsory	, ory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering: semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri	e: Compulsory sering: Compulsory Compulsory ring: Compulsory sering: Compulsory sering: Compulsory sering: Compulsory	ory ring: Compulsory
Credit points Examination Examination duration and scale Assignment for the	6 Written exam 120 min General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering: semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri	e: Compulsory sering: Compulsory Compulsory ring: Compulsory sering: Compulsory sering: Compulsory sering: Compulsory	ory ring: Compulsory
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Credit points Examination Examination duration and scale Assignment for the	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering: semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical	e: Compulsory sering: Compulsory Compulsory ring: Compulsory eering: Compulsory eering: Compulsory I Engineering, F Engineering, F Engineering, Focal Engineering,	ory Focus Mechatroni ocus Biomechani us Aircraft Syste Focus Materials
Credit points Examination Examination duration and scale Assignment for the	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering; semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical semester): Specialisation Mechanical	e: Compulsory sering: Compulsory Compulsory ring: Compulsory eering: Compulsory eering: Compulsory I Engineering, F Engineering, Focal Engineering, eering, Focus Th	ory ring: Compulsory Focus Mechatroni ocus Biomechani us Aircraft Syste Focus Materials eoretical Mechani
Credit points Examination Examination duration and scale Assignment for the	General Engineering Science (German program): General Engineering Science (German program): General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory	Core Qualification: Compulsory semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Naval Architecture semester): Specialisation Civil Engineering; semester): Specialisation Electrical Enginee semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical semester): Specialisation Mechanical	e: Compulsory sering: Compulsory Compulsory ring: Compulsory eering: Compulsory eering: Compulsory I Engineering, F Engineering, Focal Engineering, eering, Focus Th	ory Focus Mechatroni ocus Biomechani us Aircraft Syster Focus Materials eoretical Mechani

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

Bioprocess Engineering: Core Qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

General Engineering Science (English program): Core Qualification: Compulsory

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:

Computational Science and Engineering: Core Qualification: Compulsory

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Core Qualification: 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 Time and according to the control of the	
	First and second order systems, poles and zeros, impulse and step response Chability.	
	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	
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Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0730: Comp	outer Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)	In	Recitation Section (small)	1	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge				
	The successful completion of the labs will be honored durules:	ring the evaluation of the module's e	xamination acco	rding to the following
	rules:			
	1. Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs, such that the examination's marks are lifted by 0,3 or 0,4, respectively, up to the next-better grade.			
	2. The improvement of the grade 5,0 up to 4,3 and 0	of 4,3 up to 4,0 is not possible.		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the function		s the layers fro	m the assembly-leve
	programming down to gates. The module includes the fo	illowing topics:		
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boo		ombinational net	works
	Sequential logic: Flip-flops, automata, systematic Technological foundations	nardware design		
	Computer arithmetic: Integer addition, subtractio	n, multiplication and division		
	Basics of computer architecture: Programming m	odels, MIPS single-cycle architecture,	pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, cac	hes		
	Input/output: I/O from the perspective of the CPU	principles of passing data, point-to-p	oint connections	, busses
Skills	The students perceive computer systems from the archi	tect's perspective, i.e., they identify t	he internal struc	ture and the physica
	composition of computer systems. The students can ana	lyze, how highly specific and individu	ual computers ca	n be built based on a
	collection of few and simple components. They are abl		ain the different	abstraction layers o
	today's computing systems - from gates and circuits up	to complete processors.		
	After successful completion of the module, the studen	s are able to judge the interdepend	lencies between	a physical compute
	system and the software executed on it. In particular, t			
	on the hardware-centric abstraction layers from the ass the impact that these low abstraction levels have on an			
	the impact that these low abstraction levels have on an	entire system s performance and to p	nopose reasible	options.
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.			
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
	90 minutes, contents of course and labs			
scale		ualification, Compulsor,		
Assignment for the Following Curricula	General Engineering Science (German program): Core Q General Engineering Science (German program, 7 seme		e: Compulsory	
ronowing curricula	General Engineering Science (German program, 7 seme			ory
	General Engineering Science (German program, 7 seme			•
	General Engineering Science (German program, 7 seme	ster): Specialisation Civil Engineering	Compulsory	
	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Engine	ering: Compulsor	у
	General Engineering Science (German program, 7 seme	- ·		-
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme			
	Compulsory	eester, opecialisation reciname	gccg,	. ocus i recharionnes
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering,	Focus Biomechanics
	Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, Fo	cus Aircraft System
	Engineering: Compulsory	competer). Consisting ##/	ol Engine	Focus Makadala 1
	General Engineering Science (German program, 7 Engineering Sciences: Compulsory	semester): specialisation Mechanic	.aı Erigineering,	rocus Materiais II
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engi	neering, Focus T	neoretical Mechanica
	Engineering: Compulsory	,· -p		
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Eng	ineering, Focus	Product Developmen
	and Production: Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, Foo	cus Energy Systems
	Computer Science: Core Qualification: Computery			
	Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Core Qu	alification: Compulsory		
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General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

Course L0321: Computer Engineering		
Тур	ecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	 Introduction Combinational Logic Sequential Logic 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. 	

Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0324: Computer Engineering	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0829: Foun	dations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882)		Recitation Section (large)	2	3
Introduction to Management (L088	0)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence Knowledge	After taking this module, students know the important be and Organisation to Marketing and Innovation, and also t			
Skills	explain the differences between Economics and important definitions from the field of Managemen explain the most important aspects of and goals projects describe and explain basic business functions organization and human ressource management, iexplain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and selection to the first project in a team. In particular, the analyse Management goals and structure them ap analyse organisational and staff structures of complete in the first project in a team.	t in Management and name the most as production, procurement and so information management, innovation making in Business, esp. in situal mathematical Finance cted controlling methods. to different criteria (organization, obthey are able to	t important aspe ourcing, supply management ar tions under mul	cts of entreprneurial chain management, d marketing tiple objectives and
	 apply methods for decision making under multiple analyse production and procurement systems and analyse and apply basic methods of marketing select and apply basic methods from mathematica apply basic methods from accounting, costing and 	Business information systems I finance to predefined problems	nder risk	
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an en to communicate appropriately and to cooperate respectfully with their fellow students Students are able to work in a team and to organize the team themselv to write a report on their project.	i.	pherent report on	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and	several written exams during the semester			
scale Assignment for the Following Curricula	General Engineering Science (German program): Speciali		-	
	General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program): Speciali General Engineering Science (German program, 7 semes General Engineering Science (German program)	sation Bioprocess Engineering: Composation Energy and Enviromental Enginestion Civil- and Enviromental Enginestion Mechanical Engineering: Composation Mechanical Engineering: Composation Naval Architecture: Compulsor Ler): Specialisation Process Engineering: Specialisation Biomedical Engineering: Specialisation Naval Architecture: Specialisation Naval Architecture: Specialisation Computer Science Ler): Specialisation Bioprocess Engineering: Specialisation Civil Engineering: Eter): Specialisation Civil Engineering: Eter): Specialisation Energy and Envirogemester): Specialisation Mechanica	pulsory ineering: Compuls eering: Compuls pulsory ry puring: Compulsory ng: Compulsory eering: Compulsory ee	ory ry ring: Compulsory Focus Mechatronics:
		_		

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsorv

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester); Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course L0882: Management Tutorial Typ Recitation Section (large)

Hrs/wk	2
СР	3
Workload	Independent Study Time 62, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek
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 busing knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Module M0854: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1 2	1
Complex Functions (L1038) Complex Functions (L1041)		Lecture Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz	-		
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	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 the	n these concepts. They are capable of		-
Skills	Students can model problems in Mathematics IV capable of solving them by applying established r Students are able to discover and verify further lo For a given problem, the students can develop results.	nethods. ngical connections between the concep	ts studied in the	e course.
Personal Competence Social Competence				
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equa	tions 2)		
scale				
Assignment for the	General Engineering Science (German program): Specia	lisation Electrical Engineering: Compul	sory	
Following Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program):	Specialisation Mechanical Engineeri	ng, Focus The	eoretical Mechanical
	Engineering: Compulsory General Engineering Science (German program): Specia	lication Naval Architecture: Compular	v	
	General Engineering Science (German program): Specia General Engineering Science (German program, 7 seme	·	-	,
	General Engineering Science (German program, 7 series			·
	Compulsory	,	gg,	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engine	eering, Focus Th	neoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Naval Architecture	e: Compulsory	
	Computer Science: Specialisation Computational Mather	matics: Elective Compulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Speciali		-	
	General Engineering Science (English program): Special			ompulsor:
	General Engineering Science (English program): Speciali General Engineering Science (English program): Special Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Electrical Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanical	Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 seme:	ster): Specialisation Mechanical Engine	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory General Engineering Science (English program, 7 semes	ter): Specialisation Naval Architecture:	Compulsory	
	Computational Science and Engineering: Specialisation I	•		
ı	Computational Science and Engineering. Specialisation i		3	ı

Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Specialisation Mechatronics: Compulsory
Mechatronics: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk		
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 	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1044: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1045: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1038: Complex Functions		
Тур	Lecture	
Hrs/wk	2	
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 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 Fund	ourse L1041: Complex Functions		
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 L1042: Complex Functions	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0960: Mech	anics IV (Kinetics II, Oscillations, Anal	ytical Mechanics, Multibo	dy Systems	3)
Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillation	ns, Analytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students can			
	 describe the axiomatic procedure used in mechan 	nical contexts;		
	 explain important steps in model design; 			
	 present technical knowledge. 			
Skills	The students can			
	explain the important elements of mathematical	/ mechanical analysis and model form	nation, and appl	y it to the context of
	their own problems;			
	 apply basic methods to engineering problems; 			
	 estimate the reach and boundaries of the method 	ds and extend them to be applicable to	wider problem	sets.
Personal Competence				
Social Competence	The students can work in groups and support each othe	r to overcome difficulties.		
Autonomu	Children and conclude of deharmaining their course through			ing based on these
Autonomy	Students are capable of determining their own strengths	s and weaknesses and to organize the	ir time and learn	ing based on those.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program): Specia	lisation Mechanical Engineering: Com	oulsorv	
Following Curricula				
3	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory			
	General Engineering Science (German program, 7 seme	·	-	ory
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme			. ,
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special		,	
	General Engineering Science (English program, 7 semes			rv
	General Engineering Science (English program, 7 semes	- ·		-
	General Engineering Science (English program, 7 semes	- ·		• 1
	Mechanical Engineering: Core Qualification: Compulsory		. Compaisory	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Scie	nce: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complem		Compulsory	
	Theoretical Mechanical Engineering. Technical Completi	ichtary Course Core Studies. Liettive	compuisory	

Course L1137: Mechanics IV	(Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1139: Mechanics IV	(Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0680: Fluid	Dynamics			
Courses				
Title Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Thomas Rung	· •		
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics, enginee	ring mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices. Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on a			
Personal Competence Social Competence	scientific level. The students are able to discuss problems and jointly develop solution strategies.			
Autonomy	The students are able to develop solution strategies for	complex problems self-consistent and	crtically analyse	results.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program): Specia		•	
Following Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia General Engineering Science (German program, 7 seme			nrv
	General Engineering Science (German program, 7 seme	- ·		•
	General Engineering Science (German program, 7 seme			.,
	General Engineering Science (English program): Special			
	General Engineering Science (English program): Special	isation Biomedical Engineering: Comp	ulsory	
	General Engineering Science (English program): Special	isation Naval Architecture: Compulsor	у	
	General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical Engine	ering: Compulsor	ry .
	General Engineering Science (English program, 7 semes			У
	General Engineering Science (English program, 7 semes			
	Computational Science and Engineering: Specialisation		Isory	
	Mechanical Engineering: Core Qualification: Compulsory	•		
	Naval Architecture: Core Qualification: Compulsory	51 6		
	Technomathematics: Specialisation III. Engineering Scie	nce: Elective Compulsory		

Course L0454: Fluid Mechani	ics
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	 Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows
Literature	 Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004

Course L0455: Fluid Mechanics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0640: Stoch	astics and Ship Dynamics				
Courses					
Title Ship Dynamics (L0352)		Typ Lecture	Hrs/wk	CP 3	
Ship Dynamics (L1620)	is Nevel Asshifts and Occas Fasis assis (10004)	Recitation Section (small)	1 2	1	
	in Naval Architecure and Ocean Engineering (L0364)	Lecture	2	3	
Module Responsible	Prof. Moustafa Abdel-Maksoud				
Admission Requirements Recommended Previous	None				
Knowledge	Technical mechanics				
Kilowicage	 Linear algebra, analysis, complex numbers 				
	Fluid mechanics				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results			
Professional Competence					
Knowledge	- The students are able to give an overview over various mand procedure of the manoeuvres.	oeuvres. They can name applic	ation goals and th	ey can describe the	
	- The students are able to give an overview over varius rudder	types. They can name criteria	in the rudder desi	gn.	
	- 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 the students are able to determine hydrodynamic coefficient. The students can explain how a rudder works and they can explain the students can mathematically describe waves.	s and they can explain their phexplain the physical effects which	nysical meaning. ch can occur.		
	- The students can explain the mathematically description of h	iarmonciai motions in waves ar	id they can detern	nine tnem.	
Personal Competence					
Social Competence	- The students can arrive at work results in groups and docume	ent them.			
	- The students can discuss in groups and explain their point of	view.			
Autonomy	- The students can assess their own strengthes and weaknesse	es and the define further work	steps on this basis		
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70				
Credit points	7				
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the					
Following Curricula		pecialisation Naval Architectur	e: Compulsory		
	Naval Architecture: Core Qualification: Compulsory	Course Floctive Commuter			
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory			

Course L0352: Ship Dynamics	s
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships
	 Equations of motion Hydrodynamic forces and moments Linear equations and their solutions Full-scale trials for evaluating the maneuvering performance Regulations for maneuverability Rudder Seakeeping Representation of harmonic processes Motions of a rigid ship in regular waves Flow forces on ship cross sections Strip method Consequences induced by ship motion in regular waves Behavior of ships in a stationary sea state Long-term distribution of seaway influences
Literature	 Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University of Technology, 2014 Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United Kingdom, 2000 Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada,1978 Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993 Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Berlin Heidelberg, Deutschland, 1992 Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, United Kingdom, 1990 Handbuch der Werften, Deutschland, 1986 Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001 Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability, Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989 Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004 Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998

Course L1620: Ship Dynamics		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Moustafa Abdel-Maksoud	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0364: Statistics and	Stochastic Processes in Naval Architecure and Ocean Engineering
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	 descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, John Wiley & Sons, Inc., New York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and Statistics, Springer, 2005 Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006 A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013

Module M0655: Comp	utational Fluid Dynamics I				
Courses					
Title		Тур	Hrs/wk	СР	
Computational Fluid Dynamics I (LC		Lecture	2	3	
Computational Fluid Dynamics I (LC	0419)	Recitation Section (large)	2	3	
Module Responsible	Prof. Thomas Rung				
Admission Requirements	None				
Recommended Previous	Mathematical Methods for Engineers				
Knowledge	Fundamentals of Differential/integral calculus and ser	ies expansions			
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results			
Professional Competence					
Knowledge	The students are able to list the basic numerics of partial dif	ferential equations.			
Skills	The students are able develop appropriate numerical integr		overning partial dif	ferential equations.	
	They can code computational algorithms in a structured way	/.			
Personal Competence					
Social Competence	The students can arrive at work results in groups and docun	nent them.			
Autonomy	The students can independently analyse approaches to solv	ing specific problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and	2h				
scale					
Assignment for the	General Engineering Science (German program, 7 semester	: Specialisation Naval Architectu	ire: Compulsory		
Following Curricula					
	Elective Compulsory				
	Energy Systems: Technical Complementary Course Core Stu	• •			
	General Engineering Science (English program, 7 semester)				
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical	Engineering, Focu	s Energy Systems:	
	Elective Compulsory				
	Mechanical Engineering: Specialisation Energy Systems: Ele	ctive Compulsory			
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science:	Flective Compulsory			
	recimomathematics, specialisation III. Engineering Science:	Liective Compulsory			

Course L0235: Computationa	
Тур	Lecture
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	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: 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	

Module M0659: Fundamentals of Ship Structural Design and Analysis					
Courses					
Title Fundamentals of Ship Structural Design (L0411) Fundamentals of Ship Structural Design (L0413) Fundamentals of Ship Structural Analysis (L0410)		Le Re Le	yp ecture ecitation Section (small) ecture	Hrs/wk 2 1 2	CP 2 2 2
Fundamentals of Ship Structural A		Re	ecitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers				
Admission Requirements					
Recommended Previous					
Knowledge	Fundamentals of Materials Science I - III				
	Welding Technology I Fundamentals of Mechanical Design I - III				
	Tundamentals of Mechanical Design 1- III				
Educational Objectives	After taking part successfully, students have rea	ached the following	learning results		
Professional Competence			-		
Knowledge	Students can reproduce the basic contents of th	ne structural behavi	our of ship structures; the	y can explain the	theory and methods
	for the calculation of deformations and stresses	in beam-like struct	ures.		
	Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished products, joining and principles of structural design of components in the ship structure.				
Skills	Students are capable of applying the methods and tools for the calculation of linear deformations and stresses in the above mentioned structures; they can choose calculation models of typical ship structures. Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they can select suitable materials,				
	semi-finished products and joints.	alloas of arawing a	nd sizing the sinp structu	re, they can selec	e suitable materials,
Personal Competence					
Social Competence	The students are able to communicate and coindustry.	operate in a profes	ssional environment in th	e shipbuilding an	d component supply
Autonomy	The students are capable to independently idealize real ship structures and to select suitable methods for analysis of beam-like structures; they are capable to assess the results of structural analyses.				
	Furthermore, they are capable to assess dra requirements and boundary conditions.	awings of complex	ship structures and to	o design ship sti	ructures for various
Workload in Hours	Independent Study Time 156, Study Time in Lec	ture 84			
Credit points					
· · · · · · · · · · · · · · · · · · ·	Written exam				
Examination duration and					
scale					
Assignment for the	General Engineering Science (German program,	7 semester): Speci	alisation Naval Architectu	re: Compulsory	
Following Curricula			alisation Naval Architectur	e: Compulsory	
	Naval Architecture: Core Qualification: Compulso	ory			

Course L0411: Fundamentals 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	s of Ship Structural Design
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Chapters:
	1. Introduction
	3. Class societies and their tasks
	4. Materials for steel shipbuilding
	5. Welding and Cutting
	6. Semi-finished products in steel shipbuilding
	7. Determining the scantlings for local loads
	8. Longitudinal strength of the hull girder
	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	s of Ship Structural Analysis
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Contents:
	1. Introduction
	Finite element method (f.e. method) by the example of trussworks
	3. Force methods for frameworks
	4. F.e. method for frameworks
	5. Shear and torsion in thin-walled beams
	6. Beams subjected to longitudinal forces
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

Course L0414: Fundamentals of Ship Structural Analysis		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Contents:	
	1. Introduction	
	2. Finite element method (f.e. method) by the example of trussworks	
	3. Force methods for frameworks	
	4. F.e. method for frameworks	
	5. Shear and torsion in thin-walled beams	
	6. Beams subjected to longitudinal forces	
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente	

Module M0664: Struc	tural Design and Construction o	f Ships			
Courses					
Title Ship Structural Design (L0412) Ship Structural Design (L0415)		Typ Lectu Recita	re ation Section (small)	Hrs/wk 2 2	CP 3 3
Welding Technology (L1123)		Lectu	re	3	3
Module Responsible	Prof. Sören Ehlers				
Admission Requirements	None				
Recommended Previous					
Knowledge	Fundamentals of Materials Science I - III				
	Welding Technology I				
	Fundamentals of Mechanical Design I - III				
Educational Objectives	After taking part successfully, students have re	eached the following lea	rning results		
Professional Competence					
Knowledge	Students can reproduce design and sizing as w (incl. detail design); they can describe calculat		•	tructures and of	f different ship types
Skills	Students are capable to specify the requirem components, to select suitable calculation mod	•		ull, to define d	esign criteria for the
Personal Competence					
-	Students are capable to present their structura	l design and discuss the	eir decisions constructive	ly in a group.	
Autonomy	Students are capable to design independently	y different structural ar	eas of the ship hull and	different ship	types and to define
	appropriate fabrication methods.				
	Independent Study Time 172, Study Time in Le	ecture 98			
	9				
	Written exam				
	3 hours				
scale	Consent Fundamenta y Col. (C	7	antico Marcal A. 100	C	
Assignment for the	General Engineering Science (German program	•			
Following Curricula	General Engineering Science (English program		ation Naval Architecture:	compuisory	
	Naval Architecture: Core Qualification: Compul	SULY			

Course L0412: Ship Structural Design		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	SoSe	
Content	Chapters:	
	1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting	
	7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	

Typ Recitation Section (small) Hrs/wk 2 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Sören Ehlers Language DE Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 11. Safety factors and reliability of structures	Course L0415: Ship Structural Design		
Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Sören Ehlers Language DE Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength	Тур	Recitation Section (small)	
Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Sören Ehlers 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	Hrs/wk	2	
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	СР	3	
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	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
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	Lecturer	Prof. Sören Ehlers	
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	Language	DE	
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	Cycle	SoSe	
 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 	Content	Chapters:	
Literature Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	Literature	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	

Course L1123: Welding Technology		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer	
Language	DE	
Cycle		
Content	- phase transitions, phase diagrams and thermal activated processes	
	- fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams	
	- properties of weldable carbon and fine grained steels	
	- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels	
	- structure and properties of non-ferrite metals (aluminum, titanium)	
	- NDT/DT Methods for materials and welds	
	- gas fusion welding, fundamentals of electric arc welding technologies	
	- structure and influence parameters for the welded joint	
	- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding	
	- resistance welding/ polymer welding/ hybrid-welding	
	- deposition welding	
	- electron beam welding/ laser beam welding	
	- weld joint designs and declarations	
	- computation methods for weld joint dimensioning	
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.	
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.	
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.	

Module M1109: Resis	tance and Propulsion			
Courses				
Title		Тур	Hrs/wk	СР
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Mechanics			
Knowledge	Fluid Dynamics for Naval Architects			
	Hydrostratics			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for resi			
	phenomena and their practical applications to hullform	-		-
	of the course. Furthermore, environmental additional r			
	their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake.			
	Main Focus is how hull forms can be optimized for minin	num and sustainable fuel consumption	in. The following t	opics are deait with:
	- Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws,			
	laminar/turbulent flow separation, Hull form design for	or redcude flow separation, Append	age Design and	$resistance, \ Froude's$
	resistance law,form factor method, thrust deduction, w	ake, model scaling laws, resistance	tests, free runnin	g propeller tests and
	propeller basics, propulsion tests, full scale speed pow	ver predictions, additional resistance	s (wind, steering	, current, sea state),
	EEDI, speed trials, contractual matters concerning speed	d/power, bunker claims		
Skille	The student shall learn to design competitve hull forms	with respect to fuel consumption by	anniving numrei	cal techniques and to
Skills	evaluate these hulls by several progosis methods.			
	minimize the required power including environmental in		the stadent to t	determine und
Personal Competence				
,	The student learns to prepare technical matters in such	•	-	
Autonomy	The student learns to prepare technical matters in such	a way that he can compte with his b	uilding suvervisio	n team.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Naval Architectu	re: Compulsory	
Following Curricula	General Engineering Science (English program, 7 semes	ter): Specialisation Naval Architectu	e: Compulsory	
	Naval Architecture: Core Qualification: Compulsory			

Course L1265: Resistance and Propulsion	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	
Literature	

Course 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

Module MIIIO. Hydro	statics and Body Plan			
Courses				
Title		Тур	Hrs/wk	СР
Hydrostatics (L1260)		Lecture	2	3
Hydrostatics (L1261)		Recitation Section (large)	2	1
Body Plan (L1452)		Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Good knowledge in Mathemathics I-III and Mechanics I-III.			
Knowledge	It is recommended that the students are familiar with	cypical design relevant drawings, e.g. B	ody Plan, GA- Pla	n, Tank Plan etc.
Educational Objectives	After taking part successfully, students have reached to	he 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			ific level. The lecture
	is basic requirement for all following lectures in the subjects shipo design and safety of ships.			
Skills	The student is able to carry out hydrostatic calculation	ons to ensure that the ship has sufficie	ent stability. He is	able to design hull
	forms that are safe against capsizing or sinking.		,	J
Personal Competence				
Social Competence	The student gets access to hydrostatical problems.			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architectur	e: Compulsory	
Following Curricula	General Engineering Science (English program, 7 seme	ester): Specialisation Naval Architecture	e: Compulsory	
	Naval Architecture: Core Qualification: Compulsory			

	Naval Architecture: Core Qualification: Compulsory
Course L1260: Hydrostatics	
Typ	Lecture
Hrs/wk	
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	
Language	
	SoSe 1. Numerical Integration, Diffrentation, Interpolation
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods
	- Determination of Areas, 1st and 2nd order Moments
	- Numerical Diffrentation, Spline Interpolation
	2. Buyoancy
	- Principle of Archimedes
	- 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
	[504]

- 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
Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Course L1261: Hydrostatics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1452: Body Plan	
Тур	Project Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Module M0933: Funda	amentals of Materials Science			
Carriera				
Courses				
Title Fundamentals of Materials Science	1/(1105)	Typ Lecture	Hrs/wk 2	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. 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	ring learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on r	netals, ceramics and	polymers and can descri	be this knowledge
	comprehensively. Fundamental knowledge here means specific	ally the issues of atom	nic structure, microstructur	re, phase diagrams,
	phase transformations, corrosion and mechanical properties. The	ne students know abou	ut the key aspects of chara	cterization methods
	for materials and can identify relevant approaches for cha	racterizing specific p	roperties. They are able	to trace materials
	phenomena back to the underlying physical and chemical laws	of nature.		
Skills	The students are able to trace materials phenomena back t	o the underlying phy	sical and chemical laws o	of nature. Materials
	phenomena here refers to mechanical properties such as stre			
	resistance, and to phase transformations such as solidificatio			
	between processing conditions and the materials microstructu	ire, and they can acc	ount for the impact of mi	crostructure on the
	material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Mechanic	cal Engineering: Compulsor	У
Following Curricula	General Engineering Science (German program, 7 semester): S			У
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S		na Enviromental Engineeri	ng: Compulsory
	Energy and Environmental Engineering: Core Qualification: Con		al Engineering: Campulate	,
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp		3 3 .	•
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp		3 3 , ,	,
	General Engineering Science (English program, 7 semester): Sp			a: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elect			.5. 55
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		

Course L1085: Fundamentals of Materials Science I			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Jörg Weißmüller		
Language	DE		
Cycle	WiSe		
Content			
Literature	Vorlesungsskript		
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7		

Course L0506: Fundamentals	Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	ecture		
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 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 0	Chemical Basics of Materials Science		
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Stefan Müller		
Language	DE		
Cycle	WiSe		
Content	 Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems) 		
Literature	Für den Elektromagnetismus: • Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter Für die Atomphysik: • Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: • Hornbogen, Warlimont: "Metallkunde", Springer		

Module M1110: Ship	Design			
Courses				
Title		Тур	Hrs/wk	СР
Ship Design (L1262)		Lecture	2	3
Ship Design (L1264)	I	Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	 Fluid Dynamics for Naval Architects, Resistance and 	Propulsion		
Knowledge	Resistance and Propulsion, Hydrostatics			
Educational Objectives	After talking your groups the state of the s	allowing looping possibe		
Educational Objectives	After taking part successfully, students have reached the f	bllowing learning results		
Professional Competence	The lecture starts with an overview about the importance	and requirements of the aerly de	sian nhasa Com	anatitiva Flamants of
Knowieuge	Ship Designs are thoroughly discussed. Typical bulding cor			
	main parameters of a ship are introduced and their influ			
	influence of alternated main parameters on the total perfo	·	-	
	lecture, the design changes are dealt with by simple m	odels or formulae. The student s	hall further lear	n to model complex
	systems properly so that the relavent technical conclusions	can be drawn.		
	The lecture continues with an introduction into the differe	nt phases of design project from	the initial design	nhase to a building
	contract. Further, methods are introduced to generate bu			
	during the different design stages. In detail, the following t			,
		•		
	- Structure of a building specification			
	- Determination of Light Ship Weight and Deadweight			
	Components			
	- Design of main section and hull form			
	- Design of aftbody lines and manoevering devices			
	- Design of main propulsion plant			
	- Design of subdivision			
	Determination of limiting GMrequ- Curves Scantlings of most improtant structural members			
	- Longitudinal strength			
	- Outfitting Components			
	- Relevant rules and regulations			
Skills	The student is made familiar with the basic design princ		-	
	student shall be able to carry out a concept design based	•		
	the Marine Environment. The lecture deals with the basic of a ship design with respect to fulfillment procedures of t			
	relevant methods to determine and judge uopn the perform		ecture Trincipie.	3 of Ship Design the
	and judge dopn the perior			
Personal Competence				
Social Competence	The students learns to prepare technical matters in si	ich a way the he can persuade	his potantial c	ustomer against his
4	competitors.		his service s	
Autonomy	The students learns to prepare technical matters in s competitors.	ucii a way tile ne can persuade	nis potantial c	uscomer against his
	competitors.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the		•		
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture	:: Compulsory	
	Naval Architecture: Core Qualification: Compulsory			

Course L1262: Ship Design		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Workload in Hours Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1264: Ship Design		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Specialization Process Engineering

Process engineering is the engineering discipline that conducts research into, develops, and realizes material change processes. It deals as a cross-sectional science with the conversion of materials in their nature, their properties, or their composition by means of physical, chemical, and biological processes with a view to producing usable intermediate or end products such as fuels, sugar, synthetics, proteins, cosmetics, dyestuffs, alcohols, plant protection products, or medications.

To achieve these targets, the process engineering study program aims to enable students to recognize and formulate laws by means of which apparatus, machinery, and entire manufacturing plants can be planned, calculated, designed, built, and operated. The product qualities required are to be achieved by means of safe and environmentally compatible processes and a rational use of energy and raw materials.

Module M0886: Funda	amentals of Process Engineerin	g and Material Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Introduction into Process Engineering/Bioprocess Engineering (L0829)		Lecture	2	1
Fundamentals of material engineer		Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	After passing this module the students have t	the ability to:		
	give an overview of the most importan	t fields on process and bioprocess engineer	ing,	
	 explain some working methods for diffe 	erent fields in process engineering.		
Skills	After passing this module the students should	d have the ability to:		
	list and outline the most important field			
		roaches or methods of the different fields of	f process engineering,	
	read and prepare an engineering draw			
		es for wastewater and exhaust air treatmen		
	scheme typical chemical and biotechnol	ological processes independently with the a	id of pointers.	
Personal Competence				
Social Competence	The students are able to			
	 work out results in groups and docume 	ant them		
		dle feedback on their own performance cons	structively	
	provide appropriate recabacit and name	are recapacit on their own personnance com	on derivery.	
Autonomy	The students are able to estimate their prog	gress of learning by themselves and to deli	iberate their lack of k	nowledge in Process
	Engineering and Bioprocess Engineering.			
Workload in Hours	Independent Study Time 34, Study Time in Le	ecture 56		
Credit points	3			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German progra	m): Specialisation Process Engineering: Con	npulsory	<u> </u>
Following Curricula	General Engineering Science (German progra	m): Specialisation Bioprocess Engineering:	Compulsory	
	General Engineering Science (German progra	m, 7 semester): Specialisation Process Engi	ineering: Compulsory	
	General Engineering Science (German progra	m, 7 semester): Specialisation Bioprocess E	ingineering: Compulso	ry
	Bioprocess Engineering: Core Qualification: Co	ompulsory		
	General Engineering Science (English program	n): Specialisation Bioprocess Engineering: C	Compulsory	
	General Engineering Science (English program	n): Specialisation Process Engineering: Com	pulsory	
	General Engineering Science (English program			
	General Engineering Science (English program		ngineering: Compulsor	у
	Process Engineering: Core Qualification: Com	pulsory		

Course L0829: Introduction into Process Engineering/Bioprocess Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des SD V	
Language	DE	
Cycle	WiSe	
Content	Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.	
Literature	s. StudIP	

Course L0830: Fundamentals	s of material engineering
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012.

Module M0937: Physi	cal Chemistry			
Courses				
Title		Тур	Hrs/wk	СР
Physical Chemistry (L0833)		Lecture	2	2
Physical Chemistry (L0835)		Practical Course	2	1
Module Responsible	Prof. Hans-Ulrich Moritz			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemistry, ph	ysics for engineers and mather	natics I-III.	
Knowledge	***			
_	After taking part successfully, students have reached the	following learning results		
Professional Competence	The students are able,			
Knowieuge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of ma	ass-, heat- and momentum tra	insfer.	
	- to interpret phase diagrams and affiliate kinetic rate laws	5.		
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemica	al and kinetic calculations.		
	- assess new applications with respect to environmental s	ustainability.		
	- abstract their knowldege to related issues to conduct the	ermodynamical, electrochemica	al and kinetic calculation	ons.
Personal Competence				
-	The students are able to plan, prepare, conduct and docur	ment experiments according to	scientific guidelines ir	small groups.
	The students are able to reflect their subject-specific know	rledge orally in a team and to o	discuss it with fellow st	udents and faculty.
Autonomy	Students are able to assess their knowldege continuously	y on their own by exemplified	practice. Students are	able to apply their
	knowldege discretely to plan, prepare and conduct experi	ments.		
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56			
Credit points	3			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program): Specialis	ation Process Engineering: Cor	npulsory	
Following Curricula	General Engineering Science (German program): Specialis			
	General Engineering Science (German program, 7 semest	-		
	General Engineering Science (German program, 7 semestr		ingineering: Elective C	ompulsory
	Bioprocess Engineering: Core Qualification: Elective Comp			
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program): Specialisa			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	r): Specialisation Bioprocess Er	ngineering: Elective Co	mpulsory
	Process Engineering: Core Qualification: Compulsory			

Course L0833: Physical Chen	nistry
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Abetz
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces
Literature	P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013 P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008 G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012 R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993 U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011

Course L0835: Physical Chemistry		
Тур	Practical Course	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Volker Abetz	
Language	DE	
Cycle	WiSe	
Content	Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:	
	Reaction kinetics	
	Freezing-point depression (cryoscopy)	
	Electrical mobility of ions	
	Viscosimetry	
	Heat of neutralization	
	Surface tension	
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.	
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.	
Literature	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter	
	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html	

Module M0730: Comp	outer Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)	In 6.1. 1. 5.1.	Recitation Section (small)	1	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge				
	The successful completion of the labs will be honored do	uring the evaluation of the module's e	xamination acco	rding to the following
	rules:			
	Upon a passed module examination, the student such that the examination's marks are lifted by 0 The improvement of the grade 5.0 up to 4.2 and	,3 or 0,4, respectively, up to the next-		the successful labs
	2. The improvement of the grade 5,0 up to 4,3 and	or 4,3 up to 4,0 is not possible.		
Educational Objectives		e following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the function programming down to gates. The module includes the form		s the layers fror	n the assembly-leve
	programming down to gates. The module includes the in	onowing topics.		
	Introduction			
	 Combinational logic: Gates, Boolean algebra, Boo Sequential logic: Flip-flops, automata, systematic 		ombinational net	works
	Technological foundations	nardware design		
	Computer arithmetic: Integer addition, subtractio	n, multiplication and division		
	Basics of computer architecture: Programming m	odels, MIPS single-cycle architecture,	pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, cad			
	Input/output: I/O from the perspective of the CPU	, principles of passing data, point-to-p	oint connections	, busses
Skills	The students perceive computer systems from the arch	tect's perspective, i.e., they identify t	he internal struc	ture and the physica
	composition of computer systems. The students can an			
	collection of few and simple components. They are abl	- '	ain the different	abstraction layers o
	today's computing systems - from gates and circuits up	to complete processors.		
	After successful completion of the module, the studen			
	system and the software executed on it. In particular, t	·		
	on the hardware-centric abstraction layers from the ass the impact that these low abstraction levels have on an			
Personal Competence	Charles and the second similar marks and a second		a walka ada s	
	Students are able to solve similar problems alone or in a			
Autonomy	Students are able to acquire new knowledge from speci-	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			
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
	General Engineering Science (German program): Core Q	ualification: Compulsory		
Following Curricula			e: Compulsory	
	General Engineering Science (German program, 7 seme	ster): Specialisation Bioprocess Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 seme	•		
	General Engineering Science (German program, 7 seme		. ,	
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme	- · ·		
	General Engineering Science (German program, 7 seme	- · ·		•
	General Engineering Science (German program, 7 seme		-	3 ,,
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering,	Focus Mechatronics
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	Engineering, I	Focus Biomechanics
	Compulsory General Engineering Science (German program, 7 se	emester): Specialisation Mechanical	Engineering Fo	rus Aircraft Systems
	Engineering: Compulsory	mester). Specialisation Mechanical	ingineering, roc	as Aircraft System.
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical Engir	eering, Focus Th	neoretical Mechanica
	Engineering: Compulsory	actorily Connectation M. J. J. T.	inandr - F	December 19
	General Engineering Science (German program, 7 sem and Production: Compulsory	ester): Specialisation Mechanical Eng	neering, Focus F	roduct Developmen
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical I	Engineerina. For	us Enerav Systems
	Compulsory	- , - p - state and it is a state of the sta	Jg, . 00	5, 5,500113
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Core Qu	ualification: Compulsory		

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Computational Science and Engineering: Core Qualification: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory

Course L0321: Computer Eng	gineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 Introduction Combinational Logic Sequential Logic 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.

Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0324: Computer Engineering	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0536: Funda	amentals of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (I		Lecture	2	4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous	Mathematics I+II+III			
Knowledge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	Simplification and solving of partial difference	erential equations		
	Integration			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence	The taking part succession, y students have to	cachea and long wing learning results		
•	Students are able to:			
	explain the difference between different	**		
		ons of the Reynolds Transport-Theorem in proc		ione
	explain simplifications of the Continuity-	- and Navier-Stokes-Equation by using physica	ii boundary condit	10115
Skills	The students are able to			
	describe and model incompressible flow	vs mathematically		
		mechanics by simplifications to archive quant	itative solutions e	a by integration
	notice the dependency between theory		inderve solderons e	.g. by meegration
	, , , ,	cal applications in fields of process engineering	3	
Personal Competence				
Social Competence	The students			
	are capable to gather information from	subject related, professional publications and	I relate that inforr	nation to the contex
	of the lecture and			
	able to work together on subject relate	ed tasks in small groups. They are able to pre	sent their results	effectively in Englis
	(e.g. during small group exercises)			
	are able to work out solutions for exerci	ises by themselves, to discuss the solutions or	ally and to presen	t the results.
Autonomy	The students are able to			
·				
	· ·	and to expand their knowledge with this literat		
	work on their exercises by their own and	d to evaluate their actual knowledge with the	теепраск.	
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and	3 hours			
scale				
Assignment for the	General Engineering Science (German progran	m): Specialisation Process Engineering: Compu	lsory	
•	General Engineering Science (German program		•	
-	General Engineering Science (German program	m): Specialisation Energy and Enviromental En	gineering: Compu	lsory
	General Engineering Science (German progran	m, 7 semester): Specialisation Process Enginee	ering: Compulsory	
	General Engineering Science (German progran	n, 7 semester): Specialisation Bioprocess Engi	neering: Compulso	ory
	General Engineering Science (German progran	n, 7 semester): Specialisation Energy and Env	iromental Enginee	ring: Compulsory
	Bioprocess Engineering: Core Qualification: Co	ompulsory		
	Energy and Environmental Engineering: Core C	· ·		
	General Engineering Science (English program			
	General Engineering Science (English program	· ·		sory
	General Engineering Science (English program		-	
		· · · · · ·		•
			omenicai Engineer	ing. Compulsory
	General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program Technomathematics: Specialisation III. Enginee Process Engineering: Core Qualification: Comp	n, 7 semester): Specialisation Bioprocess Engir n, 7 semester): Specialisation Energy and Envir ering Science: Elective Compulsory	eering: Compulso	-

Course L0091: Fundamentals	of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, th 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 solution 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 Strömunger Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWFachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubne Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Module M0544: Phase	Equilibria Thermodynamics			
Courses				
Title		Тур	Hrs/wk	СР
Phase Equilibria Thermodynamics (L0114)	Lecture	2	2
Phase Equilibria Thermodynamics (Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (L0142)	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous		ics Land II		
Knowledge	Trachemates, Thysical enemistry, Thermodynam			
3				
Educational Objectives	After taking part successfully, students have rea	chod the following learning recults		
	After taking part successfully, students have rea	cried the following learning results		
Professional Competence				
Knowledge	Starting from the very basics of thermod	lynamics, the students learn the mathematic	cal tools to des	cribe thermodynamic
	equilibria.			
	They learn how state variables are influence	enced by the mixing of compounds and learn	concepts to qu	uantitatively describe
	these properties.			
	Moreover, the students learn how phase	equilibria can be described mathematically	and which pher	nomena may occur if
	different phases (vapor, liquid, solid) coex	ist in equilibrium. Furthermore the fundament	als of reaction e	equilibria are taught.
	For different phase equilibria, several ex	camples relevant for different kinds of proce	esses are show	n and the necessary
	knowledge for plotting and interpreting th	e equilibria are taught.		
Skills				
Skiiis	 Applying their knowledge, the students a 	are able to identify the correct equation for	the determination	on of the equilibrium
	state and know how to simplify these equa	ations meaningfully.		
	 The students know models which can be 	used to determine the properties of the syste	em in the equili	brium state and they
	are able to solve the resulting mathematic	cal relations.		
	 For specific applications, they are able to 	self-reliantly find necessary physico-chemica	properties of c	ompounds as well as
	model parameters in literature sources.			
	 Beside pure compound properties the stud 	dents are capable of describing the properties	of mixtures.	
	 The students know how to visualize phase 	equilibria graphically and they know how to i	nterpret the occ	urring phenomena.
	 Based on their knowledge, the student 	s are able to understand fundamental con	cepts that are	the basis for many
	separation and reaction processes in chen	nical engineering.		
Personal Competence				
Social Competence	The students are able to work in small groups,	to solve the corresponding problems and to	oresent them or	alv to the tutors and
, , , , , , , , , , , , , , , , , , , ,	other students	3 h		,
Autonomy				
Adconomy	 The students are able to find necessary in 	formation self-reliantly in literature sources a	nd to judge their	quality.
	 During the semester the students are a 	able to check their learning progress contin	nuously in exer	cises. Based on this
	knowledge the students can adept their le	arning process.		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure ob		
Credit points				
Examination	Written exam			
	120 minutes; theoretical questions and calculation	ons		
scale				
Assignment for the	General Engineering Science (German program):	Specialisation Process Engineering: Compulse	ory	
Following Curricula	General Engineering Science (German program):	Specialisation Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (German program,	7 semester): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (German program,	7 semester): Specialisation Bioprocess Engine	ering: Compulso	ory
	Bioprocess Engineering: Core Qualification: Com	pulsory		
	General Engineering Science (English program):	Specialisation Bioprocess Engineering: Compu	ılsory	
	General Engineering Science (English program):	Specialisation Process Engineering: Compulso	ry	
	General Engineering Science (English program, 7	semester): Specialisation Process Engineerin	g: Compulsory	
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Enginee	ering: Compulso	ry
	Process Engineering: Core Qualification: Compuls	· · ·	•	
	·			

Course L0114: Phase Equilib	ria Thermodynamics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	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 GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3 rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course L0140: Phase Equilib	ria Thermodynamics	
Тур	Recitation Section (small)	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	SoSe	
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure The students work on tasks in small groups and present their results in front of all students.	
	 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			
СР			
Workload in Hours	dependent 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: 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. 3rd ed. Prentice Hall, 1997.J.P. O´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 		

Module M0672: Signa	als 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 and syst		-	
	1-3 is expected. Further experience with spectral transformation	ations (Fourier series, Fourier tra	insform, Laplace	transform) is useful
	but not required.			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
•	The students are able to classify and describe signals and lir	near time-invariant (LTI) systems	using methods	of signal and system
i.i.o.ieage	theory. They are able to apply the fundamental transformati		-	-
	can describe and analyse deterministic signals and systems			
	understand the effects in time domain and image domain	•	-	
	discrete-time signal.	which are caused by the transit	ion or a continu	lous time signar to a
Skille	The students are able to describe and analyse deterministic	signals and linear time-invariant	evetame using r	nethods of signal and
Skills	system theory. They can analyse and design basic system			
	response, stability, linearity etc They can assess the impact			
Personal Competence		or Err systems on the signal proj	berties in time a	nd frequency domain.
•				
	The students can jointly solve specific problems.			
Autonomy	· ·		-	control their level of
	knowledge during the lecture period by solving tutorial proble	ems, software tools, clicker syste	m.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program): Specialisation	on Electrical Engineering: Compu	Isory	
Following Curricula	General Engineering Science (German program): Specialisation	on Computer Science: Compulsor	У	
	General Engineering Science (German program): Specialisation	on Process Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	on Bioprocess Engineering: Comp	oulsory	
	General Engineering Science (German program): Specialisation	on Civil- and Enviromental Engen	eering: Compuls	ory
	General Engineering Science (German program): Specialisation	on Mechanical Engineering: Com	oulsory	
	General Engineering Science (German program): Specialisation	on Biomedical Engineering: Comp	oulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Electrical Enginee	ring: Compulsor	у
	General Engineering Science (German program, 7 semester):	Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engine	eering: Compuls	ory
	General Engineering Science (German program, 7 semester):	Specialisation Biomedical Engine	eering: Compuls	ory
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineering,	Focus Biomechanics:
	Compulsory			
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical E	Engineering, Foo	cus Energy Systems:
	Compulsory			
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical I	Engineering, Fo	cus Aircraft Systems
	Engineering: Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semester)	Specialisation Mechanical Engir	eering, Focus T	neoretical Mechanical
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program): Specialisatio	n Civil- and Enviromental Engene	eering: Compuls	ory
	General Engineering Science (English program): Specialisatio	n Bioprocess Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Electrical Engineering: Compul	sory	
	General Engineering Science (English program): Specialisatio			
	General Engineering Science (English program): Specialisatio	n Mechanical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Biomedical Engineering: Comp	ulsory	
	General Engineering Science (English program): Specialisatio	n Process Engineering: Compulso	ory	
	General Engineering Science (English program, 7 semester):	Specialisation Electrical Engineer	ing: Compulsory	,
	General Engineering Science (English program, 7 semester):	Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering	ng: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical	Engineering,	ocus Biomechanics:
	Compulsory			
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical E	Engineering, Foo	us Energy Systems:
	·			

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems	
Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering	
Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:	
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	
Engineering: Compulsory	
Computational Science and Engineering: Core Qualification: Compulsory	
Computational Science and Engineering: Core Qualification: Compulsory	
Mechatronics: Core Qualification: Compulsory	
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

Course L0432: Signals and S	systems
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language	
Cycle	
Content	Basic classification and description of continuous-time and discrete-time signals and systems
	Concvolution
	Power and energy of signals
	Correlation functions of deterministic signals
	Linear time-invariant (LTI) systems
	Signal transformations:
	Fourier-Series
	Fourier Transform
	Laplace Transform
	Discrete-time Fourier Transform
	Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)
	Z-Transform
	Analysis and design of LTI systems in time and frequency domain
	Basic filter types
	Sampling, sampling theorem
	Fundamentals of recursive and non-recursive discrete-time filters
Literature	T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004
	K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.
	B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997
	• J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002
	• S. Haykin, B. van Veen: Signals and systems. Wiley.
	Oppenheim, A.S. Willsky: Signals and Systems. Pearson.
	Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.

Course L0433: Signals and S	ourse L0433: Signals and Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0938: Biopr	ocess Engineering - Fundamentals			
Courses				
Title Bioprocess Engineering - Fundamer Bioprocess Engineering- Fundamer		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 1
Bioprocess Engineering - Fundame	ntal Practical Course (L0843)	Practical Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	None			
Recommended Previous Knowledge	none, module "organic chemistry", module "fundamen	itals for process engineering"		
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
	Students are able to describe the basic concepts of bi enzymes and microorganisms, as well as to differe rheology can be named and mass transport process fundamental bioprocess management, sterilization ted. After successful completion of this module, students si describe different kinetic approaches for growth predict qualitatively the influence of energy generatation process analyze bioprocesses on basis of stoichiometry distinguish between scale-up criteria for differe	entiate different types of inhibition. To see in bioreactors can be explained. Inhology and downstream processing in thould be able to an and substrate-uptake and to calculate generation, regeneration of redox equivalent	The parameters of The students are noted to the corresponding ivalents and group the corresponding the	of stoichiometry and e capable to explain ng parameters wth inhibition on the
Personal Competence Social Competence	propose solutions to complicated biotechnologic to explore new knowledge resources and to app identify scientific problems with concrete indust to document and discuss their procedures as we After completion of this module participants should be take position to their own opinions and increase their or	oly the newly gained contents crial use and to formulate solutions. ell as results in a scientific manner e able to debate technical questions in	small teams to e	-
Autonomy	After completion of this module participants will be alworkflow and to present their results in a plenum.	ole to solve a technical problem in a te	eam independent	ly by organizing their
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
-	General Engineering Science (German program): Spec General Engineering Science (German program): Spec General Engineering Science (German program, 7 sem General Engineering Science (German program, 7 sem Bioprocess Engineering: Core Qualification: Compulsor General Engineering Science (English program): Speci	ialisation Bioprocess Engineering: Com nester): Specialisation Process Engineer nester): Specialisation Bioprocess Engir ry	pulsory ring: Compulsory neering: Compulso	ory
	General Engineering Science (English program): Special General Engineering Science (English program, 7 semi General Engineering Science (English program, 7 semi Biomedical Engineering: Specialisation Artificial Organ Biomedical Engineering: Specialisation Implants and E Biomedical Engineering: Specialisation Medical Technol Biomedical Engineering: Specialisation Management a Technomathematics: Specialisation III. Engineering Sci Process Engineering: Core Qualification: Compulsory	alisation Process Engineering: Compuls ester): Specialisation Process Engineering: Specialisation Process Engineering ester): Specialisation Bioprocess Enginess and Regenerative Medicine: Compulsory ology and Control Theory: Elective Comnuls Business Administration: Elective Comnuls Elective Elective Comnuls Elective	sory ing: Compulsory eering: Compulso sory	ry

Course L0841: Bioprocess En	gineering - Fundamentals
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	 Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese) Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese) Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng) Kinetic of subtrate consumption and product formation (Prof. Zeng) Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese) Transport process in a bioreactor (Prof. Zeng) Technology of sterilization (Prof. Zeng) Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese) Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)
Literature	 K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013

Course L0842: Bioprocess En	
Тур	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	1. Introduction (Prof. Liese, Prof. Zeng)
	2. Enzymatic kinetics (Prof. Liese) 3. Stoichiometry I + II (Prof. Liese) 4. Microbial Kinetics I+II (Prof. Zeng) 5. Rheology (Prof. Liese)
	6. Mass transfer in bioprocess (Prof. Zeng) 7. Continuous culture (Chemostat) (Prof. Zeng) 8. Sterilisation (Prof. Zeng) 9. Downstream processing (Prof. Liese) 10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)
Literature	siehe Vorlesung

Course L0843: Bioprocess En	Course L0843: Bioprocess Engineering - Fundamental Practical Course		
Тур	Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng		
Language	DE		
Cycle	SoSe		
Content	In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out. The students document their experiments and results in a protocol.		
Literature	Skript		

Module M1497: Meas	urement Technology for VT/ BV	т		
Courses				
Title		Тур	Hrs/wk	СР
Practical Course Measurement Tecl	nnology (L2270)	Practical Course	2	2
Measurement Technology (L2268)		Lecture	2	2
Physical Fundamentals of Measurer	ment Technology (L2269)	Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lo	ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Process Engin	eering: Compulsory	<u> </u>
Following Curricula	Bioprocess Engineering: Core Qualification: C	Compulsory		
	General Engineering Science (English progra	m, 7 semester): Specialisation Process Engine	eering: Compulsory	
	Orientierungsstudium: Core Qualification: Ele	ective Compulsory		
	Process Engineering: Core Qualification: Com	pulsory		

Course L2270: Practical Cour	ourse L2270: Practical Course Measurement Technology	
Тур	Practical Course	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Michael Schlüter	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L2268: Measurement Technology		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexandra von Kameke	
Language	DE	
Cycle	WiSe	
Content		
Literature		

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		
Literature		

Module M0538: Heat	and Mass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge				
	The students are capable of explaining qualitative heat explanation should be a store.	and determining quantitative heat	transfer in proced	iural apparatus (e. g.
	heat exchanger, chemical reactors). They are capable of distinguish and characterize of	lifferent kinds of heat transfer med	hanisms namely h	eat conduction, heat
	transfer and thermal radiation.	amerene kinds of flede transfer fried	nameny n	leat conduction, neat
	The students have the ability to explain the ph	vsical basis for mass transfer in	detail and to de:	scribe mass transfer
	qualitative and quantitative by using suitable mass			
	They are able to depict the analogy between heat-		complex linked pr	ocesses in detail.
CI:II-				
Skills	The students are able to set reasonable system by	ooundaries for a given transport pr	oblem by using th	ne gained knowledge
	and to balance the corresponding energy and mas	s flow, respectively.		
	 They are capable to solve specific heat transfer p 	roblems (e.g. heated chemical rea	ctors, temperatur	e alteration in fluids)
	and to calculate the corresponding heat flows.			
	Using dimensionless quantities, the students can e	execute scaling up of technical proc	esses or apparatu	S.
	They are able to distinguish between diffusion, co.	nvective mass transition and mass	transfer. They car	n use this knowledge
	for the description and design of apparatus (e.g. e.			
	In this context, the students are capable to choose	-	neat and mass exc	changer for a specific
	application considering their advantages and disac		va a a duval a ma a rat	
	 In addition, they can calculate both, steady-state a The students are capable to connect their known 			
	particular the courses thermodynamics, fluid me			
	problems.	channes and enemical process en	gineering, to solv	e concrete teenmear
	p. 22.2			
Personal Competence				
Social Competence				
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	The students are capable to work on subject-spec	ific challenges in teams and to pre	esent the results o	rally in a reasonable
	manner to tutors and other students.			
Autonomy				
,	The students are able to find and evaluate necessar	•		
	They are able to prove their level of knowledge	-		continuously (clicker-
	system, exam-like assignments) and on this basis	they can control their learning proc	esses.	
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56			
	Written exam			
	120 minutes; theoretical questions and calculations			
Scale	Congral Engineering Science (Cormon program 7	tor), Chacialization Process Francis	ring, Commiles	
-	General Engineering Science (German program, 7 semes	- · ·		nr.
Following Curricula	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 semes	· ·		-
	Bioprocess Engineering: Core Qualification: Compulsory	ter). Specialisation Energy and Env	nomentai Enginee	ring. Compuisory
	Energy and Environmental Engineering: Core Qualification: Compulsory	n: Compulsory		
	General Engineering Science (English program, 7 semest	• •	ina: Compulsory	
	General Engineering Science (English program, 7 semest			rv
	General Engineering Science (English program, 7 semest			-
	Technomathematics: Specialisation III. Engineering Scien			- 1
	Process Engineering: Core Qualification: Compulsory	. ,		

Course L0101: Heat and Mass Transfer			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer		
Literature	Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions 1. H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer 2. VDI-Wärmeatlas		

Course L0102: Heat and Mass Transfer		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1868: Heat and Mass Transfer		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0546: Theri	mal Separation Processes				
Courses					
Title		Тур	Hrs/wk	СР	
Thermal Separation Processes (LO		Lecture	2	2	
Thermal Separation Processes (L0119)		Recitation Section (small)	2	2	
Thermal Separation Processes (L03 Separation Processes (L1159)	141)	Recitation Section (large) Practical Course	1	1	
Module Responsible	Prof. Irina Smirnova				
Admission Requirements					
•	Recommended requirements: Thermodynamics III				
Knowledge					
Educational Objectives	After taking part successfully students have reached the	following loarning results			
Educational Objectives Professional Competence		e following learning results			
Knowledge					
nnomeage	The students can distinguish and describe diffe	rent types of separation processes	such as distillat	tion, extraction, and	
	adsorption				
	 The students develop an understanding for the c energy demand of a process, the possibilities of el 				
	They have good knowledge of designing methods				
	mey have good knowledge of designing methods	or separation processes and device.			
Skills					
SKIIIS	Using the gained knowledge the students can selection.	ect a reasonable system boundary fo	or a given separa	tion process and can	
	close the associated energy and material balance:				
	The students can use different graphical metho	ds for the designing of a separatio	n process and d	efine the amount of	
	theoretical stages required	wood according process for a given		the educates and	
	 They can select and design a basic type of the disadvantages of the process 	rmai separation process for a giver	case based on	the advantages and	
	The students are capable to obtain independently	the needed material properties fro	m appropriate so	urces (diagrams and	
	tables)	, ,		(g	
	They can calculate continuous and discontinuous	processes			
	The students are able to prove their theoretical kr	nowledge in the experimental lab wo	k.		
	• The students are able to discuss the theoretical background and the content of the experimental work with the teachers in				
	colloquium.				
	The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of				
	technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.				
Personal Competence					
Social Competence					
bociai competence	The students can work technical assignments in statements.	mall groups and present the combine	ed results in the t	utorial	
	The students are able to carry out practical lab to them. They are able to discuss their results and to			ion of labor between	
	them. They are able to discuss their results and to	document them scientifically in a re	port.		
Autonomy		formation from cuitable courses by th	omeolyoe and ac	cocc their quality	
	The students are capable to obtain the needed inf The students can proof the state of their know	•			
	learning process	reage than exam resembling assign	circo aria iii ci	ns may control them	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination					
Examination duration and					
Scale		tor): Specialisation Process Engineer	ing: Compulsory		
Assignment for the Following Curricula		- ·		orv	
. oog curricula	General Engineering Science (German program, 7 semes			-	
	Bioprocess Engineering: Core Qualification: Compulsory		3	_ , , , , ,	
	Energy and Environmental Engineering: Core Qualification	n: Compulsory			
	General Engineering Science (English program, 7 semest	er): Specialisation Process Engineeri	ng: Compulsory		
	General Engineering Science (English program, 7 semest	er): Specialisation Bioprocess Engine	eering: Compulso	ry	
	General Engineering Science (English program, 7 semest	er): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory	
	Process Engineering: Core Qualification: Compulsory				

Course L0118: Thermal Sepa	ration Processes				
Тур	Lecture				
Hrs/wk	2				
СР	2				
Workload in Hours	dependent 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 Energy demand of separation processes Advance overview of separation processes Selection of separation processes 				
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 				

Course L0119: Thermal Sepa	ration Processes				
Тур	Recitation Section (small)				
Hrs/wk	2				
СР	2				
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28				
Lecturer	of. Irina Smirnova				
Language	DE				
Cycle	WiSe				
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students.				
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 				

Course L0141: Thermal Sepa	ration Processes				
Тур	Recitation Section (large)				
Hrs/wk	1				
СР	1				
Workload in Hours	dependent Study Time 16, Study Time in Lecture 14				
Lecturer	of. Irina Smirnova				
Language	DE				
Cycle	WiSe				
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 				
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 				

Course L1159: Separation Pro	cesses
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
en_mh_head_studienleistung	Compulsory attendence of the colloquia of all experiments and compulsory report.
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 can increase their capabilities in this area.
	Topics of the practical course:
	Introduction in the thermal process engineering and to the main features of separation processes
	Simple equilibrium processes, several steps processes
	Distillation of binary mixtures, enthalpy-concentration diagrams
	Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
	Extraction: separation ternary systems, ternary diagram
	Multiphase separation including complex mixtures
	Designing of separation devices without discrete stages
	Drying
	Chromatographic separation processes
	Membrane separation
	Energy demand of separation processes
	Advance overview of separation processes Selection of consection processes
	Selection of separation processes
Literature	G. Brunner: Skriptum Thermische Verfahrenstechnik
	I. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980
	Sattler: Thermische Trennverfahren, VCH, Weinheim 1995
	J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.
	Mersmann: Thermische Verfahrenstechnik, Springer, 1980
	Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997
	Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation
	processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.
	R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.
	• Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984
	Ullmann"s Enzyklopädie der Technischen Chemie

Module M0892: Chem	ical Reaction Engineering				
Courses					
Title		Тур	Hrs/wk	СР	
Chemical Reaction Engineering (Fundamentals) (L0204)		Lecture	2	2	
Chemical Reaction Engineering (Fu		Recitation Section (large)	2	2	
Experimental Course Chemical Eng		Practical Course	2	2	
Module Responsible					
Admission Requirements					
Recommended Previous	'	II, physical chemistry, technical thermo	dynamics I+II as v	vell as computational	
Knowledge	methods for engineers.				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence					
Knowledge	The students are able to explain basic concepts of	chemical reaction engineering. They are	e able to point out	differences between	
	thermodynamical and kinetical processes. The stu	idents have a strong ability to outline p	parts of isotherma	l and non-isothermal	
	ideal reactors and to describe their properties.				
Skills	After successful completion of the module, student	s are able to:			
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,				
	- determine and compute stable operation points for these reactors ,				
	- conduct experiments on a lab-scale pilot plants ar	nd document these according to scientific	guidelines.		
Personal Competence					
Social Competence	After successful completition of the lab-course the	students have a strong ability to organ	ize themselfes in	small groups to solve	
	issues in chemical reaction engineering. The stud	ents can discuss their subject related k	nowledge among	each other and with	
	their teachers.				
Autonomy	The students are able to obtain further inform	ation and assess their relevance aut	onomously. Stude	nts can apply their	
	knowldege discretely to plan, prepare and conduct	experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84			
Credit points	6				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Process Engine	ering: Compulsory		
Following Curricula	General Engineering Science (German program, 7 s	emester): Specialisation Bioprocess Eng	ineering: Compuls	ory	
	Bioprocess Engineering: Core Qualification: Compu	sory			
	Bioprocess Engineering: Core Qualification: Comput	sory			
	General Engineering Science (English program, 7 se	emester): Specialisation Process Enginee	ring: Compulsory		
	General Engineering Science (English program, 7 se	emester): Specialisation Bioprocess Engir	neering: Compulso	ry	
	Process Engineering: Core Qualification: Compulsory				
Process Engineering: Core Qualification: Compulsory					

Тур	Lecture
Hrs/wk	2
СР	2
orkload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
	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 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 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 system. Lagrange Multipliers) Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements.

half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with preequilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature

lecture notes Raimund Horn

skript Frerich Keil

Rooks

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
- O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000 $\,$
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course L0244: Chemical Reaction Engineering (Fundamentals)		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup	
Language	DE	
Cycle	WiSe	
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)	
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of	

reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

Literature

lecture notes Raimund Horn

skript Frerich Keil

Books:

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- 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		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch		
Language	DE/EN		
Cycle	SoSe		
Content	Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors:		
	* Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate		
	*CSTR - Residence time distribution, reaction		
	*CSTR in Series - Residence time distribution, reaction		
	* Plug Flow Reactor - Residence time distribution, reaction		
	Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice.		
	The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course.		
Literature	Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)		
	Praktikumsskript		
	Skript Chemische Verfahrenstechnik 1 (F.Keil)		

Module M1275: Environmental Technology				
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (L1387)		Practical Course	1	1
Environmental Technologie (L0326))	Lecture	2	2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biolo	pgy		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	With the completion of this modul the students obtain	profound knowledge of environme	ntal technology. They	are able to describe
	the behaviour of chemicals in the environment. Stude	nts can give an overview of scient	ific disciplines involve	ed. They can explain
	terms and allocate them to related methods.			
Skills	Students are able to propose appropriate managemen	ant and mitigation measures for a	nvironmontal problem	as Thoy are able to
SKIIIS	Students are able to propose appropriate manageme determine geochemical parameters and to assess the	-	•	*
	work out well founded opinions on how Environmental			
	and defend these opinions in front of and against the gr		iable development, a	ind they can present
	and defend these opinions in none of and against the gi	Toup.		
Personal Competence				
Social Competence	The students are able to discuss the various technical a	and scientific tasks, both subject-s	pecific and multidiscip	olinary. They are able
	to develop different approaches to the task as a group	as well as to discuss their theoretic	cal or practical imple	mentation.
Δυτοροπν	Students can independently exploit sources about of the	ne subject, acquire the particular k	nowledge and tranfer	it to new problems
, income in y	ordanies can macpenachely explore sources about or e	to subject, acquire the particular it	nomeage and dame.	ic to new problems.
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and	1 hour			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Energy and E	inviromental Engineer	ring: Compulsory
Following Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engi	neering: Elective Com	pulsory
	General Engineering Science (German program, 7 sem	ester): Specialisation Bioprocess E	ngineering: Elective C	Compulsory
	Bioprocess Engineering: Core Qualification: Elective Co	ompulsory		
	Energy and Environmental Engineering: Core Qualificat	tion: Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Energy and E	nviromental Engineeri	ing: Compulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engin	eering: Elective Comp	oulsory
	General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Er	gineering: Elective Co	ompulsory
	Process Engineering: Core Qualification: Elective Comp	pulsory		

Course L1387: Practical Exercise Environmental Technology		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE	
Cycle	SoSe	
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515	

Course L0326: Environmental Technologie	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, Dozenten des SD V
Language	DE
Cycle	WiSe
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Module M0833: Intro	duction to Control Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Systems (Li	0654)	Lecture	2	4
Introduction to Control Systems (Li	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and fr	equency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Children and an analysis of the second state o	in the kine of the control of the co		
	 Students can represent dynamic system beha first and second order systems 	vior in time and frequency domain, and	can in particular	explain properties of
	They can explain the dynamics of simple cont.	ol loops and interpret dynamic propertie	es in terms of fre	guency response and
	root locus	or roops and meetpree aymanne properties	.5 terris or re	queriey response una
	They can explain the Nyquist stability criterion	and the stability margins derived from i	t.	
	They can explain the role of the phase margin			
	They can explain the way a PID controller affer	cts a control loop in terms of its frequenc	y response	
	They can explain issues arising when controlle	rs designed in continuous time domain a	re implemented	digitally
Skills				
Skins	Students can transform models of linear dynar	nic systems from time to frequency dom	ain and vice ver	sa
	They can simulate and assess the behavior of			
	They can design PID controllers with the help of the state of the			
	They can analyze and synthesize simple contr They can calculate discrete-time approxim			
	implementation	ations of controllers designed in con	ciridous-cirrie di	a use it for digital
	They can use standard software tools (Matlab	Control Toolbox, Simulink) for carrying o	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve ted			
Autonomy	Students can obtain information from provided sou when solving given problems.	rces (lecture notes, software document	ation, experime	nt guides) and use it
	when solving given problems.			
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	ogress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
	Written exam			
Examination duration and scale	120 min			
	Canada Engineering Caianaa (Carman nyagyan 7.aa	anneter). Considiration Commuter Cainne	a. Camanulaam.	
Assignment for the Following Curricula				arv
r ollowing curricula	General Engineering Science (German program, 7 se	· · · · · · · · · · · · · · · · · · ·		эт у
	General Engineering Science (German program, 7 se	•		
	General Engineering Science (German program, 7 se	mester): Specialisation Electrical Engine	ering: Compulsor	у
	General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engin	eering: Compuls	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	I Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program,	/ semester): Specialisation Mechanica	i Engineering,	rocus Biomechanics:
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering. Fo	cus Aircraft Systems
	Engineering: Compulsory	and the second s	Jg, . 0	3,300.113
	General Engineering Science (German program,	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials in
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical Engir	neering, Focus T	neoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (German program, 7 so	emester): Specialisation Mechanical Eng	ineering, Focus	Product Development
	and Production: Compulsory	competer). Consisting the state of the	Engineerin - F	nuc Enormy Contract
	General Engineering Science (German program, 7		Engineering, Foo	us criergy systems:
		semester). Specialisation Mechanical		
	Compulsory Bioprocess Engineering: Core Qualification: Compulsor			
	Bioprocess Engineering: Core Qualification: Compulso	ory		
		ory hematics: Elective Compulsory		
	Bioprocess Engineering: Core Qualification: Compulso Computer Science: Specialisation Computational Mat	ory hematics: Elective Compulsory y		
	Bioprocess Engineering: Core Qualification: Compulso Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor	ory hematics: Elective Compulsory y ation: Compulsory	: Compulsory	
	Bioprocess Engineering: Core Qualification: Compulso Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor Energy and Environmental Engineering: Core Qualific	ory hematics: Elective Compulsory y ation: Compulsory nester): Specialisation Computer Science		ry
	Bioprocess Engineering: Core Qualification: Compulso Computer Science: Specialisation Computational Mat Electrical Engineering: Core Qualification: Compulsor Energy and Environmental Engineering: Core Qualific General Engineering Science (English program, 7 sen General Engineering Science (English program, 7 sen	ory hematics: Elective Compulsory y ation: Compulsory nester): Specialisation Computer Science		ry

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Core Qualification: 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
Content	Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus plots Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor
	Digital control
	Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0539: Proce	ss and Plant Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Process and Plant Engineering I (L0		Lecture	2	2
Process and Plant Engineering I (L0		Recitation Section (large)	1	2
Process and Plant Engineering I (L1		Recitation Section (small)	1	2
Module Responsible Admission Requirements	None			
Recommended Previous	unit operation of thermal an dmechanical separation proces	sos		
Knowledge	unic operation of thermal an unfectialical separation proces	363		
	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical	processes		
	specify linear component equations of complex chemical pro	ocesses		
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	- formulation of mass and energy balance equations and est	timation of product streams		
	- estimation of component streams of chemical plants using linear component balance models			
	- solution of data reconcilliation tasks			
	- conduction of process synthesis			
	- economic evaluation of processes and the estimation of pr	oduction costs		
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
	General Engineering Science (German program, 7 semester). Specialisation Process Engineering	na. Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester			ory
3	General Engineering Science (German program, 7 seme			
	Compulsory	· · · · · · · · · · · · · · · · · · ·		*
	Bioprocess Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester)	: Specialisation Process Engineerin	g: Compulsory	
	General Engineering Science (English program, 7 semester)	: Specialisation Bioprocess Enginee	ering: Compulsor	ry
	General Engineering Science (English program, 7 seme	ster): Specialisation Energy and	Enviromental E	ingineering: Elective
	Compulsory			
	Process Engineering: Core Qualification: Compulsory			

Course L0095: Process and Pl	ant Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	1. Introduction
	Structure and operation of production plants
	Operational business process
	Technical process design
	Motivation and targets of process development
	Life cycle of production plants
	2. Engineering methods and tools
	Mass and energy balances
	Strategies of process synthesis
	Graphical representation of processes
	Multidimensional regression
	Data reconciliation and data validation

	3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation
Literature	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
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	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916
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	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 Plant Engineering I	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1214: Process and Plant Engineering I	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
en_mh_head_studienleistung	none
Lecturer	Prof. Georg Fieg, Dr. Thomas Waluga
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0670: Partic	cle Technology and Solids Proces	s Engineering			
Courses					
Title		Тур		Hrs/wk	СР
Particle Technology I (L0434)		Lecture		2	3
Particle Technology I (L0435)		Recitation Se	ction (small)	1	1
Particle Technology I (L0440)		Practical Cou	rse	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous	keine				
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ched the following learning re	sults		
Professional Competence					
Knowledge	After successful completion of the module stude	nts are able to			
	 name and explain processes and unit-op 	erations of solids process engi	neering		
	characterize particles, particle distribution		-		
Skills	Students are able to				
SKIIIS					
	 choose and design apparatuses and process 	esses for solids processing acc	ording to the des	sired solids prop	erties of the product
	 asses solids with respect to their behavio 	in solids processing steps			
	 document their work scientifically. 				
Personal Competence					
Social Competence	The students are able to discuss scientific top	ics orally with other students	s or scientific pe	rsonal and to d	levelop solutions for
	technical-scientific issues in a group.				
Autonomy	Students are able to analyze and solve question	s regarding solid particles ind	ependently.		
		ture 70			
	Written exam				
Examination duration and	90 minutes				
scale					
Assignment for the	General Engineering Science (German program,		-		
Following Curricula	General Engineering Science (German program,				-
	General Engineering Science (German program,		nergy and Enviro	mental Engineer	ring: Compulsory
	Bioprocess Engineering: Core Qualification: Com				
	Energy and Environmental Engineering: Core Qu		anna Familia	v. Camanulaa	
	General Engineering Science (English program,				
	General Engineering Science (English program,	•			-
	General Engineering Science (English program,	•	ergy and Environ	ieritai Engineeri	ing. Compulsory
	Process Engineering: Core Qualification: Compu	SULY			

Course L0434: Particle Techn	nology I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology 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 Techn	nology I
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE/EN
Cycle	SoSe
Content	 Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

MUOZ9: FOUN	dations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882) Introduction to Management (L088	20)	Recitation Section (large) Lecture	2 3	3
Module Responsible		Lecture	3	3
Admission Requirements	·			
	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basic and Organisation to Marketing and Innovation, and also to In			
Skills	explain the differences between Economics and M important definitions from the field of Management explain the most important aspects of and goals in I projects describe and explain basic business functions as organization and human ressource management, inform explain the relevance of planning and decision may uncertainty, and explain some basic methods from may estate basics from accounting and costing and selected. Students are able to analyse business units with respect to the content of the c	Management and name the most production, procurement and stream and stream and stream and stream at the management, innovation aking in Business, esp. in situal athematical Finance I controlling methods.	important aspe purcing, supply management ar tions under mul	cts of entreprneuri chain managemer d marketing tiple objectives ar
Skills	Students are able to analyse business units with respect to a out an Entrepreneurship project in a team. In particular, they		jectives, strateg	es etc.) and to car
	analyse Management goals and structure them appropriate appropriate analyse organisational and staff structures of compan	•		
	apply methods for decision making under multiple obj	ectives, under uncertainty and ur	der risk	
	analyse production and procurement systems and Bus	siness information systems		
	analyse and apply basic methods of marketing			
	 select and apply basic methods from mathematical fir apply basic methods from accounting, costing and cor 	·		
Personal Competence				
Social Competence	Students are able to			
Autonomy	work successfully in a team of students to apply their knowledge from the lecture to an entrep to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project.	oreneurship project and write a co	herent report on	the project
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Subject theoretical and practical work several written exams during the semester			
scale	_			
Assignment for the		: Specialisation Electrical Enginee	ring: Compulson	/
Following Curricula				
	General Engineering Science (German program, 7 semester)	: Specialisation Biomedical Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semester)	: Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semester)			ry
	General Engineering Science (German program, 7 semester)			ing. Commulacin
	General Engineering Science (German program, 7 semester) General Engineering Science (German program, 7 seme		_	
	Compulsory			
	General Engineering Science (German program, 7 seme Compulsory	ster): Specialisation Mechanical	Engineering, F	ocus Biomechanic
	General Engineering Science (German program, 7 semes Engineering: Compulsory	ter): Specialisation Mechanical I	Engineering, Foo	us Aircraft Systen
	General Engineering Science (German program, 7 sem Engineering Sciences: Compulsory	ester): Specialisation Mechanic	al Engineering,	Focus Materials
	General Engineering Science (German program, 7 semester) Engineering: Compulsory	: Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechanic
	General Engineering Science (German program, 7 semester and Production: Compulsory): Specialisation Mechanical Engi	neering, Focus F	roduct Developme
	General Engineering Science (German program, 7 semest	ter): Specialisation Mechanical E	ingineering, Foc	us Energy System
	General Engineering Science (German program, 7 semest	ter): Specialisation Mechanical E	ingineering, Foc	us Energy Syste

Compulsory

Civil- and Environmental Engineering: Core Qualification: Compulsory

Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory

Electrical Engineering: Core Qualification: Compulsory

Energy and Environmental Engineering: Core Qualification: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:

Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester); Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core Qualification: Compulsory

Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Orientierungsstudium: Core Qualification: Elective Compulsory

Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory

Course	L0882:	Management Tutorial	
	1		

Typ Recitation Section (large)

Hrs/wk

CP

Workload Independent Study Time 62, Study Time in Lecture 28

in Hours

Prof. Christoph Ihl. Katharina Roedelius, Tobias Vlcek Lecturer

DE Language

Cvcle

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 business knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction t	o Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M0891: Inform	natics for Process Engineers			
Courses				
Title Informatics for Process Engineers (L	0836)	Typ Lecture	Hrs/wk	CP 2
Informatics for Process Engineers (L		Recitation Section (small)	2	2
Numeric and Matlab (L0125)	,	Practical Course	2	2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements	None			
Recommended Previous	Basic knowledge in using MS Windows.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	owing learning results		
Professional Competence				
Knowledge	Students can describe procedural and object-oriented concep	ts.		
	Students are capable of object-oriented programming in the using Matlab. Students are capable of developing concepts (simple algorithms)		-	ematic questions by
	Students are able to work out solutions together in small grou			
Autonomy	Students are able to assess acquired skills by applying it in pr	actice.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Energy and	d Enviromental E	ngineering: Elective
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Bioprocess Engineering: Core Qualification: Compulsory	Specialisation Process Engineer	ring: Elective Com	pulsory
	Energy and Environmental Engineering: Core Qualification: Co	ompulsory		
	General Engineering Science (English program, 7 semesti		I Enviromental E	ngineering: Elective
	Compulsory	. ,		3 . 3
	General Engineering Science (English program, 7 semester): 9	Specialisation Process Engineeri	ing: Elective Comp	oulsory
	Process Engineering: Core Qualification: Compulsory			

Course L0836: Informatics fo	or Process Engineers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	Introduction to object-oriented modelling and programming exemplified with Java
	Objects, classes
	Methods, properties
	Inheritance Posice of the lenguage lave
	Basics of the language Java Sample application: Simulation of an electricity network
	2D graphics
	Events and Controls
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets,
	1998.
	Bibliothek: TII 978
	Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002.
	http://www.javabuch.de/
	Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999.
	Bibliothek: TII 717
	Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942
	Dibliotriek: 111 942
	Java SE 7 Documentation
	http://docs.oracle.com/javase/7/docs/
	Java Platform, Standard Edition 7 API Specification
	http://docs.oracle.com/javase/7/docs/api/

Course L0837: Informatics fo	r Process Engineers
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe SoSe
Content	In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two
	programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor.
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets,
Literature	1998.
	Bibliothek: TII 978
	Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002.
	http://www.javabuch.de/
	Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999.
	Bibliothek: TII 717
	Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999.
	Bibliothek: TII 942
	Java SE 7 Documentation
	http://docs.oracle.com/javase/7/docs/
	Java Platform, Standard Edition 7 API Specification
	http://docs.oracle.com/javase/7/docs/api/
1	

Course L0125: Numeric and Matlab	
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Module M1274: Enviro	onmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biol	logy		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	With the completion of this module the students	acquire in-depth knowledge of import	ant cause-effect	chains of potentia
	environmental problems which might occur from pro	duction processes, projects or construc	tion measures. T	hey have knowledg
	about the methodological diversity and are competer	nt in dealing with different methods and	instruments to a	ssess environment
	impacts. Besides the students are able to estimate the	he complexity of these environmental p	rocesses as well	as uncertainties an
	difficulties with their measurement.			
Skills	The students are able to select a suitable method fo			
	can develop suitable solutions for managing and miti			
	out Life Cycle Impact Assessments independently a			
	After finishing the course the students have the	competence to critically judge resear	rch results or of	ther publications o
	environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technical	and scientific tasks, both subject-specif	fic and multidiscip	plinary. They are ab
	to develop jointly different solutions and to discuss	their theoretical or practical impleme	ntation. Due to	the selected lectur
	topics, the students receive insights into the multi-la	yered issues of the environment protect	tion and the cond	ept of sustainabilit
	Their sensitivity and consciousness towards these s	ubjects are raised and which helps to	raise their awar	eness of their futu
	social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process and preser	nt a scientific topic independently. The	y are able to ca	rry out independer
	scientific work. They can solve an environmental prob	olem in a business context and are able	to judge results o	of other publications
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	2		
Credit points				
Examination	Written exam			
Examination duration and	1 hour written exam			
scale				
Assignment for the				
Following Curricula	General Engineering Science (German program, 7 ser			
	General Engineering Science (German program, 7 ser	- · ·	ing: Elective Com	npulsory
	Bioprocess Engineering: Core Qualification: Elective C			
	Bioprocess Engineering: Core Qualification: Elective C	• •		
	Energy and Environmental Engineering: Core Qualifications of English program, 7 com	' '	montal Engineer	ing, Compulsor:
	General Engineering Science (English program, 7 sem	***	-	
	General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem			
	Process Engineering: Core Qualification: Elective Com		ng. Elective Com	puisol y
	Process Engineering: Core Qualification: Elective Com Process Engineering: Core Qualification: Elective Com	•		
	Trocess Engineering. Core Qualification. Elective Com	pulsoi y		

Course L0860: Environmental Assessment	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer
Language	DE/EN
Cycle	SoSe SoSe
Content	Contaminants: Impact- and Risk Assessment
	Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)
	Resource and water consumption: Material flow analysis
	Energy consumption: Cumulated energy demand (CED), cost analysis
	Life cycle concept: Life cycle assessment (LCA)
	Sustainability: Comprehensive product system assessment , SEE-Balance
	Management: Environmental and Sustainability management (EMAS)
	Complex systems: MCDA and scenario method
Literature	Foliensätze der Vorlesung
	Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)

Course L1054: Environmental Assessment		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt, Dr. Anne Rödl	
Language	DE	
Cycle	SoSe	
Content	Presentation and application of free software programs in order to understand the concepts of environmental	
	assessment methods better.	
	Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	Power point Präsentationen	

Thesis

Module M-001: Bache	lor Thesis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	According to General Regulations §21 (1):
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	
-	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	
Knowedge	 The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their cour 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
Skills	opening up and establishing links with extended specialized expertise. The students are able to outline the state of research on a selected issue in their subject area.
	 The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to sol subject-related problems. With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions technical issues, and develop solutions.
	The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence Social Competence	 Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably a in a structured way. The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to t addressees. In doing so they can uphold their own assessments and viewpoints convincingly.
Autonomy	 The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within specified time frame. The students are able to identify, open up, and connect knowledge and material necessary for working on a scienti problem. The students can apply the essential techniques of scientific work to research of their own.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	12
Examination	Thesis
Examination duration and	According to General Regulations
scale	
Assignment for the	
Following Curricula	Civil- and Environmental Engineering: Thesis: Compulsory
	Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory
	Data Science: Thesis: Compulsory
	Digital Mechanical Engineering: Thesis: Compulsory
	Electrical Engineering: Thesis: Compulsory
	Energy and Environmental Engineering: Thesis: Compulsory
	Engineering Science: Thesis: Compulsory
	General Engineering Science (English program, 7 semester): Thesis: Compulsory
	Computational Science and Engineering: Thesis: Compulsory
	Logistics and Mobility: Thesis: Compulsory Machanical Engineering: 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