

## **Module Manual**

**Bachelor of Science** 

## General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2018

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## **Module Manual**

Bachelor

# General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2018

Updated: 28th September 2018

## **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 1<sup>st</sup> and the 2<sup>nd</sup> 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



- · Collaborate with both English and German speaking specialists in other disciplines
- · 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 M0701: Ch	emistry (GES)			
Courses				
Title Chemistry (GES) I (L0467) Chemistry (GES) I (L0478) Chemistry (GES) II (L0469) Chemistry (GES) II (L0479)		Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	CP 2 1 2
Module Responsible	Dr. Christoph Wutz			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	The students are able to name and to describe basic principles and applications of general chemistry (structure of matter, periodic table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorganic chemistry (acid/base, pH-value, salts, solubility,			
Skills	After successful completion of this module students are able to describe substance groups and chemical compounds. On this basis, they are capable of explaining, choosing and applying specific methods and various reaction mechanisms.			
Personal Competence				
Social Competence	Students are able to take part in discussions on chemical issues and problems as a member of an interdisciplinary team. They can contribute to those discussion by their own statements.			
Autonomy	After successful completion of this modu independently by defending proposed approaches.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	120 min			
_	General Engineering Science (English progran General Engineering Science (English progran	, ,	•	oulsory



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

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



Course L0469: Chemistry (GES) II		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Holger Gulyas	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,</li> <li>Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars</li> <li>Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction</li> <li>Practical applications and examples</li> </ul>	
Literature	<ul> <li>Gallagher, Ingram: Complete Chemistry (Oxford University Press)</li> <li>Corwin: Introductory Chemistry (Pearson)</li> <li>Burrows, Parsons, Price, Holman: Chemistry3 (Oxford University Press)</li> </ul>	

Course L0479: Chemist	ourse L0479: Chemistry (GES) II	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Holger Gulyas	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0745: Ele	ectrical Engineerin	g I			
2					
Courses			<b>T</b>	II fada	<b>OD</b>
<b>Title</b> Electrical Engineering I (L06	77)		<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 5
Electrical Engineering I (L06			Recitation Section (small)	2	1
Module Responsible	Prof. Manfred Kasper				
Admission Requirements	None				
Recommended Previous Knowledge	None				
<b>Educational Objectives</b>	After taking part success	fully, students have	e reached the following learning	results	
Professional Competence					
Knowledge	<ul> <li>description of ele</li> <li>Basic material rel</li> <li>Gauss's law,</li> <li>Ampère's law,</li> <li>induction law,</li> <li>Maxwell's equation</li> <li>concept and defire</li> </ul>	ify and analyze dir ctric and magnetic lations, on in the integral fo nition of resistance	ect current networks, fields by use of vectorial field qu orm, , capacitance and inductance.		
Skills	networks and to apply fundamental laws of ele	these to calculatectric and magne Students know to	ns between currents and voltage te and dimension networks. S tic fields and are able to deri calculate resistance, capacitance	tudent know ive and eva	w to apply the aluate relation
Personal Competence					
Social Competence			s alone or in a group and to prespassis of examples verify and dea		
Autonomy	Students are able to acquire particular knowledge using textbook in a self-learning process, to integrate, present and associate this knowledge with other fields. The students develop perseverance to also solve more complicated problems.				
Workload in Hours	Independent Study Time	110, Study Time i	n Lecture 70		
Credit points					
Studienleistung	Compulsory Bonus No 10 %	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale	120 minutes				
_			gram): Core qualification: Compi gram, 7 semester): Core qualifica	-	ulsory



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

Course L0679: Electrical Engineering I	
Тур	Recitation Section (small)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Manfred Kasper
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



	<u> </u>			
Courses				
<b>Fitle</b> Programming in C (L0083) Programming in C (L1488)		<b>Typ</b> Lecture Practical Course	<b>Hrs/wk</b> 1 1	<b>CP</b> 1
Module Responsible	Prof. Siegfried Rump			
Admission Requirements	None			
Recommended Previous Knowledge	Elementary PC handling skills Elementary mathematical skills			
Educational Objectives	After taking part successfully, stud	ents have reached the following lear	ning results	
Professional Competence				
Knowledge	<ul> <li>based on C programming and car</li> <li>basic data types (integers, floatin</li> <li>advanced data types (pointers, a</li> <li>operators (arithmetical operation</li> <li>control flow (choice, loops, jumps</li> <li>functions and macros</li> <li>important standard libraries and</li> <li>recursion</li> <li>linked lists</li> <li>The students are prepared for co C++.</li> <li>The students know how to use an so that they can write, store, comp</li> <li>Using their knowledge they are about the control of the</li></ul>	g point numbers, characters) rrays, strings, composed data types, s, logical operations, bit operations) s, conditional compilation) functions ntinuing programming lectures like	type conversion object oriented t for C programn rograms. lel and program	programming ning on a PC their solutions
Personal Competence				
Social Competence	The students are able to work in small teams to solve given weekly tasks, to identify and analyze programming errors and to present their results.			
Autonomy	The students prepare themselves using the given teaching material and solve the given programming exercises on their own.  Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience.  For details beyond the scope of the lecture the students inform themselves using the stated literature and / or by supplementary own research.			
Workload in Hours	Independent Study Time 32, Study	/ Time in Lecture 28		
Credit points	2			
Studienleistung	None			<del></del>



Examination	Written elaboration
Examination duration	1-2 coding tasks weekly
and scale	1-2 coding tasks weekly
	General Engineering Science (German program): Core qualification: Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Core qualification: Compulsory

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

Course L1488: Programming in C		
Тур	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 M0736: Lir	near Algebra					
Courses						
Title				Тур	Hrs/wk	СР
Linear Algebra (L0642)				Lecture	4	4
Linear Algebra (L0643)				Recitation Section (large)	2	2
Linear Algebra (L0645)				Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner					
Admission Requirements	None					
Recommended Previous Knowledge	None					
Educational Objectives	After taking part succe	ssfully, students h	have reache	ed the following learning	results	
Professional Competence						
Knowledge	<ul><li>appropriate ex</li><li>Students can illustrating the</li></ul>	amples.	connections			_
Skills	<ul> <li>Students can model problems in linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>					
Personal Competence						
Social Competence		m different study	programs	regular home work) in hand background knowle		
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>Students can put their knowledge in relation to the contents of other lectures.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>					
Workload in Hours	Independent Study Ti	ne 128, Study Tin	ne in Lectur	re 112		
Credit points	•					
Studienleistung						
Examination	Written exam					
Examination duration and scale	120					
Assignment for the Following Curricula		Science (English	program): C	/ Core qualification: Compu semester): Core qualifica		ulsory



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

Course L0643: Linear Algebra		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Francisco Javier Hoecker-Escuti, Jan Meichsner	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0645: Linear Algebra		
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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1081: Me	echanics I (GES)				
Courses					
		Turn	Una hade	CD	
Title Mechanics I (GES) (L1373)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3	
Mechanics I (GES) (L1374)		Recitation Section (large)	3	3	
	Prof. Radoslaw Iwankiewicz	· · · · ·			
Admission					
Requirements	None	None			
Recommended Previous Knowledge	None				
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results		
Professional					
Competence					
Knowledge	rigid bodies, structural elements and simple structures, which are at rest (in equilibrium). Such a capacity is critical to the design of many structural or engineering systems. The particular objectives of this course are to:  1. Introduce the student to the basic principles required to analyse the effects of forces applied to rigid bodies, structural elements and simple structures in equilibrium;  2. Demonstrate sound techniques of constructing and solving idealised mathematical models of real engineering systems;  3. Promote the analytical and problem-solving skills required to solve a wide variety of real engineering problems effectively.				
Skills	<ol> <li>At the end of this course the student is able to:         <ol> <li>Apply the properties of two- and three-dimensional force systems to the analysis of structural elements and simple structures in equilibrium.</li> <li>Isolate a body in equilibrium by drawing its free-body diagram on which all forces acting on the body are represented.</li> <li>Analyse the external effects of forces acting on a single body or a system of bodies in two- and three-dimensional equilibrium using the free-body diagram of the body or system.</li> <li>Analyse the internal forces in trusses and beams.</li> <li>Solve problems of equilibrium with account for dry friction.</li> <li>Determine mass centres and centroids of lines, areas and volumes.</li> </ol> </li> </ol>				
Personal Competence					
Social Competence	Students can: - work in groups and report on the			nixed teams and	
Autonomy	Students are able to: - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the aid of the mid-term test.				
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70			
Credit points	6				
Studienleistung	None				
	Written exam				
Examination duration and scale		ss center, friction, trusses, b	peams.		
_	General Engineering Science (English program General Engineering Science (English program	•	-	ulsory	



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



Typ Recitation Section (large)  Hrs/wk 3  CP 3  Workload in Hours Independent Study Time 48, Study Time in Lecture 42  Lecturer Prof. Radoslaw Iwankiewicz  Language EN  Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
CP 3  Workload in Hours Independent Study Time 48, Study Time in Lecture 42  Lecturer Prof. Radoslaw Iwankiewicz  Language EN  Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
Workload in Hours Independent Study Time 48, Study Time in Lecture 42  Lecturer Prof. Radoslaw Iwankiewicz  Language EN  Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
Lecturer Prof. Radoslaw Iwankiewicz  Language EN  Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
Language EN  Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	İ
Cycle WiSe  1. Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
Two-dimensional (2D) force systems.: moment of a force about a point, reduction of	
forces, resultant.  2. Three-dimensional (3D) force systems; moment of a force about a point and above reduction of a system of forces, resultant, wrench.  3. Supports and bearings, constraints, reactive forces, mechanical system isolation diagram. Systems with complete and incomplete fixity.  4. Equilibrium in two and three dimensions. Equations of equilibrium.  5. Plane trusses: forces in members, the method of joints and the method of section trusses.  6. Simple structures: frames and machines.  7. Mass centers and centroids of lines, areas and volumes.  8. Friction: dry friction, types of friction problems.  9. Beams: internal effects- internal forces. Internal forces in curved-in-plane members.  10. * Flexible cables.  11. * Virtual work principle.  * Denotes an additional topic.	out an axis,
Literature  1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, 4 <sup>th</sup> Edition.  2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3 <sup>rd</sup> Edition.	SI Version,



### Module M0577: Nontechnical Complementary Courses for Bachelors

Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional	

## Professional Competence

#### 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

#### Knowledge

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

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

#### The Competence Level

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

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

#### Specialized Competence (Knowledge)

Students can



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

#### Professional Competence (Skills)

In selected sub-areas students can

#### Skills

- 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.

### Personal Competences (Self-reliance)

Students are able in selected areas

#### Autonomy

- to reflect on their own profession and professionalism in the context of real-life fields of
- 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 M1139: Ph	ysics for Engineers (GES)			
Courses				
<b>Title</b> Physics for Engineers (GES Physics for Engineers (GES		Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 3
Module Responsible	Dr. Alexander Petrov			
Admission Requirements				
Recommended Previous Knowledge	Calculus and linear algebra on h     Physics on high school level	igh school level		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
	Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.  Students can relate physics topics to technical problems.			
Skills	Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving courses.			
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Credit points				
Studienleistung				
Examination  Examination duration	Written exam			
and scale	120 Minutes, 10 tasks with parts a) and b			
	General Engineering Science (English p General Engineering Science (English p			ulsory



Course L0557: Physics for Engineers (GES)		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Alexander Petrov	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Kinematics and dynamics</li> <li>Work, Energy, momentum</li> <li>Rotatory Motion, moments of inertia</li> <li>Gravitation</li> <li>Special Theory of Relativity</li> <li>Oscillations</li> <li>Waves</li> <li>Geometrical optics</li> <li>Wave optics</li> <li>Matter waves</li> <li>Fundamentals of quantum mechanics</li> </ul>	
Literature	<ul> <li>D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics – Extended Edition, 7<sup>th</sup> ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004); available in the TUHH Library 'Lehrbuchsammlung'.</li> <li>Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornton and Physics by Tipler and Mosca.</li> </ul>	

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



Module M0671: Te	chnical Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics Technical Thermodynamics		Lecture	2	4 1
Technical Thermodynamics		Recitation Section (large) Recitation Section (small)	1	1
	Prof. Gerhard Schmitz	, ,		
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Mecha	anics		
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Personal Competence	Students are familiar with the laws of Thermodyna according to 1 <sup>st</sup> law of Thermodynamics and a according to 2 <sup>nd</sup> law of Thermodynamics. They a process variables and know the meaning of dientropy and also the meaning of exergy and an Thermodynamics related diagram. They know the and are able to use the related equations of state equation and know the basics of two phase Therm  Students are able to calculate the internal energy, well as work and heat for simple change of state They are able to calculate state variables for an invariables.	are aware about the limare able to distinguish be ifferent state variables livergy. They are able to ophysical difference between they know the meaning and physical difference between they know the meaning and the enthalpy, the kinetic are and to use this calculated and for a real gas from the develop an approach.	etween state ike tempera traw the Caler an ideal g of a fundations for the om measured	y conversions variables and ture, enthalpy, rnot cycle in a and a real gas mental state of  ntial energy as e Carnot cycle. d thermal state
Autonomy	Students are able to define independently tasks, well as to find ways to use the knowledge in practic		om existing	knowledge as
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Studienleistung				
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Bioprocess 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): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory			



Course L0437: Technica	I Thermodynamics I
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	
Content	<ol> <li>Introduction</li> <li>Fundamental terms</li> <li>Thermal Equilibrium and temperature</li> <li>1 Thermal equation of state</li> <li>First law</li> <li>Heat and work</li> <li>First law for closed systems</li> <li>First law for open systems</li> <li>Equations of state and changes of state</li> <li>Changes of state</li> <li>Cycle processes</li> <li>Second law</li> <li>Carnot process</li> <li>Entropy</li> <li>Examples</li> <li>Examples</li> <li>Thermodynamic properties of pure fluids</li> <li>Thermodynamic protentials</li> <li>Calorific state variables for arbritary fluids</li> <li>state equations (van der Waals u.a.)</li> </ol>
Literature	<ul> <li>Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009</li> <li>Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012</li> <li>Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993</li> </ul>

Course 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 M0772: Ele	ectrical Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering II (L07) Electrical Engineering II (L07)	•	Lecture Recitation Section (small)	3	5 1
	· 1	necitation section (smail)	۷	ı
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Content of the Lecture "Electrical Engineering I (	Elektrotechnik I)"		
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional				
Competence	The students know the basic theory, relations			
Knowledge	transients,     the use of complex numbers and phasor     the concept of impedance,     steady state sinusoidal circuit analysis	in particular:		
Skills	<ul> <li>diodes and rectifiers,</li> <li>bipolar transistors and operational ampli</li> <li>The students are able to establish relations be networks. The students know how to apply networks.</li> <li>filter-like structures, and resonating networks.</li> <li>elements, such as diodes, bipolar transistors, ar</li> </ul>	ween time dependent curr work theory to analyze 3-ph The students know to incl	nase system ude basic r	s, transformers, ionlinear circuit
Personal Competence				
Social Competence	Students are able to solve specific problems accordingly. Students can explain concepts an deepen their understanding.			
Autonomy	Students are able to acquire particular knowledge using textbooks in a self-learning process, to integrate, present, and associate this knowledge with other fields. The students develop persistency to also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
_	General Engineering Science (English program General Engineering Science (English program			ulsory



Course L0747: Electrical Engineering II	
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Helge Fielitz
Language	EN
Cycle	SoSe
Content	<ul> <li>Transients</li> <li>Periodic and sinusoidal signals</li> <li>Power in AC circuits</li> <li>Three-phase systems</li> <li>Transformers</li> <li>Harmonic analysis, transfer functions, filters, locus curve, and Bode plot</li> <li>Resonant circuits</li> <li>Diodes and nonlinear circuits</li> <li>Bipolar transistor and operational amplifier</li> </ul>
Literature	<ul> <li>A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011)</li> <li>M. Albach: "Elektrotechnik", (Pearson, 2011).</li> </ul>

Course L0748: Electrica	urse L0748: Electrical Engineering II	
Тур	Typ Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Helge Fielitz	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0737: Ma	athematical Analysis			
Courses				
Title Mathematical Analysis (L064 Mathematical Analysis (L064 Mathematical Analysis (L064	48)	Typ Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 4 2 2	<b>CP</b> 4 2 2
		ricolation coolon (omail)		_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concept appropriate examples.</li> <li>Students can discuss logical connection illustrating these connections with the he</li> <li>They know proof strategies and can represent the strategies and can represent the strategies.</li> </ul>	ons between these concep Ip of examples.		
Skills	<ul> <li>Students can model problems in analysis with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	- Students are able to work together (e.g. on th teams (i.e., teams from different study program results appropriately (e.g. during exercise class)	ns and background knowle		
	- Students are capable of checking their under specify open questions precisely and know whe	re to get help in solving the	m.	own. They can
Autonomy	<ul> <li>Students can put their knowledge in relation to</li> <li>Students have developed sufficient persister oriented manner on hard problems.</li> </ul>			iods in a goal-
Workload in Hours	Independent Study Time 128, Study Time in Lec	ture 112		
Credit points	8			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula		): Core qualification: Compu		ulsory



Course L0647: Mathematical Analysis	
Тур	Lecture
Hrs/wk	4
СР	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	SoSe
Content	Convergence, sequences, and series  Continuity  Elementary functions  Differential calculus  Integral calculus  Sequences of functions
Literature	Königsberger: Analysis Forster: Analysis

Course L0648: Mathematical Analysis		
Тур	Recitation Section (large)	
Hrs/wk	2	
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	

Course L0649: Mathematical Analysis		
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 M1103: Me	echanics II (GES)			
Courses				
Title Machanias II (GES) (I 1417)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Mechanics II (GES) (L1417) Mechanics II (GES) (L1418)		Recitation Section (large)	2	3
Module Responsible	Prof. Radoslaw Iwankiewicz	<u>`</u>		
Admission				
Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional				
Competence		nanion of Matarials/Calida :-	to dougle:	the conscitute
	The primary purpose of the study of Mechanics of Materials/Solids is to develop the capacity to predict the effects of forces on elastic bodies, structural elements and simple structures, which are a rest (in equilibrium). Such a capacity is critical to the design of many structural or engineering systems. The particular objectives of this course are to:  1. Introduce the student to the basic principles required to analyse the effects of forces applied to elastic bodies, structural elements and simple structures in equilibrium;  2. Demonstrate sound techniques of constructing and solving idealised mathematical models of real engineering systems;  3. Promote the analytical and problem-solving skills required to solve a wide variety of real engineering problems effectively.			es, which are at eering systems.
Knowledge				atical models of
Skills	At the end of this course the student should be able to:  1. Determine average normal and shear stresses. 2. Determine shear stresses and the angle of twist due to torsion of a circular shaft. 3. Determine thermal stresses in rods. 4. Analyse statically indeterminate rods and shafts 5. Determine area moments of inertia as well as principal axes and moments of inertia. 6. Determine normal and shear stresses as well as deflections due to bending. 7. Analyse plane state of stress (stress transformation). 8. Analyse stability of equilibrium of simple systems and buckling of elastic columns. 9. Determine displacements and solve statically indeterminate problems with the aid of energy (Castigliano's) method.			
Personal Competence				
Social Competence	Students can: -work in groups and report on the present them to others, - assess the team collaboration.			nixed teams and
Autonomy	Students are able to; - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the help of the mid-term test.			ssess their own
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Studienleistung	None			
	Written exam			
	1.5 hours Mechanics of Solids: stress and transformation, moments of inertia, buckling, e		g, torsion,	bending, stress
Assignment for the	General Engineering Science (English progra General Engineering Science (English progra	m): Core qualification: Comp	-	ulsory



Course L1417: Mechanic	es II (GES)
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	SoSe
Content	<ol> <li>Normal and shear stress, average normal and shear stress.</li> <li>Normal and shear strain.</li> <li>Axial loading: elastic deformation and statically indeterminate problems. Thermal stresses. Statically indeterminate axially loaded rods.</li> <li>Area moments of inertia.</li> <li>Torsion of a circular shaft: shear strain and stress, the angle of twist.</li> <li>Bending. Pure and symmetric bending: normal strain and stress. Deflection of beams: elastic curve. Statically indeterminate beams.</li> <li>Un-symmetric bending.</li> <li>Bending with a transverse shear: shear stresses in beams. Shear flow in thin-walled members, shear center.</li> <li>Plane-stress transformation.</li> <li>Stability of equilibrium and buckling of elastic columns.</li> <li>Elastic strain energy and energy methods: Castigliano's theorem - determination of displacements and statically indeterminate problems.</li> <li>*Membrane theory of rotational shells: thin-walled pressure vessels.*</li> </ol>
Literature	<ol> <li>R.C. Hibbeler, Mechanics of Materials, Pearson, Prentice Hall, SI 2<sup>nd</sup> Edition</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI 3<sup>rd</sup> Edition</li> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4<sup>th</sup> Edition</li> </ol>

Course L1418: Mechanics II (GES)		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Radoslaw Iwankiewicz	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1348: Fu	Indamentals of Mechanical Engin	eering (GES)		
Courses				
Title Fundamentals of Mechanical Engineering (GES) (L1898)		<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3
		3		
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge about mechanics and production engineering</li> <li>Internship (Stage I Practical)</li> </ul>			
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	After passing the module, students are able to:  explain basic working principles and functions of machine elements,  explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations.			
Skills	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, technically evaluate basic designs.			
Personal Competence Social Competence	Childonto ava abla ta diaguas ta abaisal infarm	ation in the lecture supported b	oy activating	ı methods.
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points		,		
Studienleistung				
-	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula		am, 7 semester): Core qualifica	ation: Comp	ulsory



Course L1898: Fundame	entals of Mechanical Engineering (GES)
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Arthur Seibel
Language	EN
Cycle	SoSe
Content	Introduction to design     Introduction to the following machine elements
13	
Literature	

Course L1899: Fundamentals of Mechanical Engineering (GES)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Arthur Seibel	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics II (L0449)		Lecture	2	4
Technical Thermodynamics		Recitation Section (large)	1	1
Technical Thermodynamics		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics, Mechanics and Technical Thermodynamics I			
	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence Knowledge	Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between anti clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamics related diagrams. They know the laws of gas mixtures, especially			
Skills	Students are able to use thermodynamic laws for the design of technical processes. Especially the are able to formulate energy, exergy- and entropy balances and by this to optimise technic processes. They are able to perform simple safety calculations in regard to an outflowing gas from tank. They are able to transform a verbal formulated message into an abstract formal procedure.			
Personal Competence				
Social Competence	The students are able to discuss in small gr	oups and develop an approach		
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge well as to find ways to use the knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	<del></del>			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Bioprocess 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): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory

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

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	



<ul> <li>* Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples.</li> <li>* They know proof strategies and can reproduce them.</li> <li>* Students can model problems in the area of analysis and differential equations with the help the concepts studied in this course. Moreover, they are capable of solving them by apply established methods.</li> <li>* Students are able to discover and verify further logical connections between the concestudied in the course.</li> <li>* For a given problem, the students can develop and execute a suitable approach, and are a to critically evaluate the results.</li> <li>* Students are able to work together in teams. They are capable to use mathematics as common language.</li> <li>* In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.</li> <li>* Students are capable of checking their understanding of complex concepts on their own. The can specify open questions precisely and know where to get help in solving them.</li> </ul>	Module M0853: Ma	athematics III			
Title	Courses				
Analysis III (L1029) Analysis			Tyn	Hre/wk	CP
Analysis III (1.1029) Analysis III (1.1029) Professional Equations 1 (Ordinary Differential Equations) (1.1031) Professional Equations 1 (Ordinary Differential Equations) (1.1033) Professional Educational Dipolettives Professional Competence  Professional Competence  **Students can name the basic concepts in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can name the basic concepts in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can name the basic concepts in the area of analysis and differential equations with the help of examples.  **Students can model problems in the area of analysis and differential equations with the help of examples.  **Students can model problems in the area of analysis and differential equations with the help of examples.  **Students are able to discover and verify further logical connections between the concepts studied in the course.  **Students are able to discover and verify further logical connections between the concepts studied in the course.  **Students are able to discover and verify further logical connections between the concepts studied in the course.  **Students are able to work together in teams. They are capable to use mathematics are common language.  **In idioing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the 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 go oriented manner on hard					_
Personal Competence   Skills					
Differential Equations 1 (Ordinary Differential Equations) (L1033)   Rectation Section (small)   1   1			, ,	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033) Rectation Section (small) 1 1 Differential Equations 1 (Ordinary Differential Equations) (L1033) Rectation Section (large) 1 1  Module Responsible Prof Anusch Taraz  Admission Requirements Recommended Previous Knowledge  Educational Objectives Admissional Competence  Professional Competence  **Students can name the basic concepts in the area of analysis and differential equations. The area also to explain them using appropriate examples.  **Students can name the basic concepts in the area of analysis and differential equations. The area also to explain them using appropriate examples.  **Students can discussibigate connections between these concepts. They are capable illustrating these connections with the help of examples.  **Students can model problems in the area of analysis and differential equations with the help of examples.  **Students are able to discover and verify further logical connections between the concepts studied in this course. Moreover, they are capable of solving them by apply established methods.  **Students are able to discover and verify further logical connections between the concepts studied in the course.  **Students are able to work together in teams. They are capable to use mathematics are common language.  I doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the can appectly 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 go oriented manner on hard problems.  **Workload in Hours**  Credit points**  **Workload in Hours**  **Workload in Hours*	• , ,	dinary Differential Equations) (L1031)		2	2
Module Responsible   Prof. Anusch Taraz   None   None	Differential Equations 1 (Ord	dinary Differential Equations) (L1032)	Recitation Section (small)	1	1
Recommended Previous Knowledge  Educational Objectives  Professional Competence  **Students can name the basic concepts in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can model problems in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can model problems in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can model problems in the area of analysis and differential equations. They are capable illustrating these connections with the help of examples.  **Students can model problems in the area of analysis and differential equations with the help of examples.  **Students are able to discover and verify further logical connections between the concepts studied in the course.  **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 a to critically evaluate the results.  **Personal Competence**  **Students are able to work together in teams. They are capable to use mathematics as common language.  **In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners.  **Students are capable of checking their understanding of complex concepts on their own. The 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 gooriented manner on hard problems.  **Workload in Hours**  Independent Study Time 128, Study Time in Lecture 112  **Credit points**  **Workload in Hours**  Independent Study Tim	Differential Equations 1 (Ord	dinary Differential Equations) (L1033)	Recitation Section (large)	1	1
Recommends Recommends Provious Knowledge Educational Objectives  Professional Competence  - Students can name the basic concepts in the area of analysis and differential equations. They are capable to explain them using appropriate examples Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples They know proof strategies and can reproduce them.  - Students can model problems in the area of analysis and differential equations with the help of examples They know proof strategies and can reproduce them.  - Students can model problems in the area of analysis and differential equations with the help of examples They know proof strategies and can reproduce them.  - Students can model problems in the area of analysis and differential equations with the help of examples Students are able to discover and verify further logical connections between the concepts studied in this course For a given problem, the students can develop and execute a suitable approach, and are a to critically evaluate the results.  - Students are able to work together in teams. They are capable to use mathematics are common language In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover, they can design examples to check and deepen the understanding of the partners. Moreover					
Educational Objectives   Attentional Objectives   Attentional Objectives   Attentional Objectives   Attentional Competence	Requirements	None			
Professional Competence  Students can name the basic concepts in the area of analysis and differential equations. The area able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples. They know proof strategies and can reproduce them.  Students can model problems in the area of analysis and differential equations with the help the concepts studied in this course. Moreover, they are capable of solving them by apply established methods. Students are able to discover and verify further logical connections between the concest studied in the course. For a given problem, the students can develop and execute a suitable approach, and are at to critically evaluate the results.  Personal Competence  Social Competence  Social Competence  Social Competence  Students are able to work together in teams. They are capable to use mathematics as common language. In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. The 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 go oriented manner on hard problems.  Workload in Hours  Workload in Hours  Horden Park They are capable of concepts and the period of the period of the concepts and period of the		I Mathematice Lat II			
Students can name the basic concepts in the area of analysis and differential equations. The area able to explain them using appropriate examples.  Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples.  They know proof strategies and can reproduce them.  Students can model problems in the area of analysis and differential equations with the help the concepts studied in this course. Moreover, they are capable of solving them by apply established methods.  Studies 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 at to critically evaluate the results.  Personal Competence  Social Competence  Social Competence  Students are able to work together in teams. They are capable to use mathematics as common language.  In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. The 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 go oriented manner on hard problems.  Workload in Hours  Credit points  Studienleistung  Workload in Hours  My Witten exam	<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
are able to explain them using appropriate examples.  Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples.  They know proof strategies and can reproduce them.  Students can model problems in the area of analysis and differential equations with the help the concepts studied in this course. Moreover, they are capable of solving them by apply established methods.  Skills  Students are able to discover and verify further logical connections between the conce studied in the course.  For a given problem, the students can develop and execute a suitable approach, and are a to critically evaluate the results.  Personal Competence  Students are able to work together in teams. They are capable to use mathematics as common language.  In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. The 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 gooriented manner on hard problems.  Workload in Hours  Independent Study Time 128, Study Time in Lecture 112  Credit points  Written exam					
the concepts studied in this course. Moreover, they are capable of solving them by apply established methods.  Students are able to discover and verify further logical connections between the concest studied in the course.  For a given problem, the students can develop and execute a suitable approach, and are a to critically evaluate the results.  Personal Competence  Social Competence  Social Competence  Social Competence  Students are able to work together in teams. They are capable to use mathematics at common language.  In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. To 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 gooriented manner on hard problems.  Workload in Hours  Moreover, they can design examples to check and deepen the understanding of the peers.  In doing so, they can communicate new concepts according to the needs of their cooperate partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students have developed sufficient persistence to be able to work for longer periods in a gooriented manner on hard problems.  Studienleistung  None  Examination  Written exam	Knowledge	<ul> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> </ul>			
Students are able to work together in teams. They are capable to use mathematics as common language.     In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. The 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 gooriented manner on hard problems.  Workload in Hours  Independent Study Time 128, Study Time in Lecture 112  Credit points  Studienleistung  None  Examination  Written exam	Skills	<ul> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able</li> </ul>			
common language.  In doing so, they can communicate new concepts according to the needs of their cooperat partners. Moreover, they can design examples to check and deepen the understanding of the peers.  Students are capable of checking their understanding of complex concepts on their own. The 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 gooriented manner on hard problems.  Workload in Hours  Credit points  Studienleistung  None  Examination  Written exam	Personal Competence				
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 go oriented manner on hard problems.  Workload in Hours Independent Study Time 128, Study Time in Lecture 112  Credit points 8  Studienleistung None  Examination Written exam	Social Competence	<ul> <li>In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their</li> </ul>			
Credit points 8 Studienleistung None Examination Written exam	Autonomy	Students have developed sufficient persistence to be able to work for longer periods in a goal-			
Credit points 8 Studienleistung None Examination Written exam	Workload in House	Independent Study Time 128 Study Time in	a Lecture 112		
Studienleistung None  Examination Written exam		! <u></u>	I LOOKUIG I IZ		
Examination Written exam					
	Studienielstung	- INOTIG			
Examination duration	Examination	Written exam			
	Examination duration				



and scale	60 min (Analysis III) + 60 min (Differential Equations 1)
Assignment for the Following Curricula	Reperal Engineering Science (English program), Core difallification, Compilisory

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	<ul> <li>Main features of differential and integrational calculus of several variables</li> <li>Differential calculus for several variables</li> <li>Mean value theorems and Taylor's theorem</li> <li>Maximum and minimum values</li> <li>Implicit functions</li> <li>Minimization under equality constraints</li> <li>Newton's method for multiple variables</li> <li>Double integrals over general regions</li> <li>Line and surface integrals</li> <li>Theorems of Gauß and Stokes</li> </ul>
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: Different	ial Equations 1 (Ordinary Differential Equations)
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 the theory and numerical treatment of ordinary differential equations  Introduction and elementary methods Exsitence and uniqueness of initial value problems Linear differential equations Stability and qualitative behaviour of the solution Boundary value problems and basic concepts of calculus of variations Eigenvalue problems Numerical methods for the integration of initial and boundary value problems Classification of partial differential equations
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1032: Differential Equations 1 (Ordinary Differential Equations)		
Тур	Recitation Section (small)	
Hrs/wk	1	
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 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 M1105: Me	echanics III (GES)					
Courses						
Courses		T	Han hade	OD		
Title Mechanics III (GES) (L1421		Typ Lecture	Hrs/wk 3	<b>CP</b> 3		
Mechanics III (GES) (L1420		Recitation Section (small)	2	2		
Mechanics III (GES) (L1419	9)	Recitation Section (large)	1	1		
Module Responsible	Prof. Radoslaw Iwankiewicz					
Admission Requirements	l None					
Recommended Previous Knowledge	INONE					
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results			
Professional						
Competence	! !	e III (Fluid Statics Kinor	matics and	Kinatics) is to		
	The primary purpose of the study of Mechanics III (Fluid Statics, Kinematics and Kinetics) is to develop the capacity to predict the effects of forces and motions, necessary for the analysis and design of moving machine parts, different machinery, vehicles, aircraft, spacecraft, automatic control systems etc. The particular objectives of this course are to:  1. Determine the hydrostatic forces acting on different objects. 2. Analyse stability of floating bodies. 3. Analyse the kinematics and kinetics of a particle in different reference systems, 4. Analyse the motion of the system of particles and forces acting on it, 5. Analyse the plane motion of a rigid body (simple mechanism) and forces acting on it. 6. Analyse the three-dimensional motion of a rigid body and forces acting on it.					
Knowledge						
	At the end of this course the student should be ab	At the end of this course the student should be able to:				
	<ol> <li>Solve the equilibrium problems with account for hydrostatic pressure forces.</li> <li>Analyse stability of simple floating bodies.</li> </ol>					
	3. Calculate the velocity and acceleration of a particle in different reference systems.					
	4. Derive and solve the equation of motion of a particle in different reference systems.					
	5. Analyse the motion of the system of particles at impulse-momentum relationships,	nd forces acting on it with	the aid of w	ork-energy and		
Skills	6. Calculate the instantaneous linear and angular velocities and accelerations of the Skills mechanisms.					
	7. Derive and solve the equations of a plane motion	on of a rigid body and find	I forces actin	ng on it,		
	8. Apply work-energy and impulse-momentum rela	ationships to analyse plan	e kinetics of	fa rigid body.		
	9. Calculate the instantaneous linear and ar dimensional motion of a rigid body.	ngular velocities and ac	celerations	of the three-		
	10. Derive the equations of a motion of a three-di	mensional motion of a rig	id body.			
	11. Apply in three-dimensional kinematics and kinem	inetics of rigid body both	methods of	vector algebra		
Personal Competence						
Social Competence	Students can: - work in groups and report on the fi present them to others, - assess the team collabor		lutions in mi	ixed teams and		
Autonomy	Students are able to: -solve the problems indep strengths and weaknesses, e.g. with the aid of the	-	f hints, - as	sess their own		
Workload in Hours	Independent Study Time 96, Study Time in Lecture					
Credit points						
Studienleistung						
	<u> </u>					



Examination	Written exam
<b>Examination duration</b>	2 nours Fluid Statics: hydrostatic pressure, buoyancy, stability of floating vessels. Kinematics of
and scale	Written exam 2 hours Fluid Statics: hydrostatic pressure, buoyancy, stability of floating vessels. Kinematics of particle, of plane and 3D rigid body. Kinetics of particle, system of particles, of plane and 3D rigid body. Vector and matrix algebra formulation.
Assignment for the	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory

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

Course L1420: Mechanics III (GES)		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Radoslaw Iwankiewicz	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1419: Mechanics III (GES)			
Typ Recitation Section (large)			
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Radoslaw Iwankiewicz		
Language	EN		
Cycle	WiSe		
Content	<ol> <li>Plane kinematics of a rigid body.</li> <li>Relative (compound) motion.</li> <li>Three-dimensional kinematics of a rigid body.</li> <li>KINETICS</li> <li>Kinetics of a particle and of a system of particles.</li> <li>Plane kinetics of a rigid body.</li> <li>Three-dimensional kinetics of a rigid body.</li> </ol>		
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley &amp; Sons, SI Version, 4<sup>th</sup> Edition</li> <li>R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3<sup>rd</sup> Edition</li> </ol>		



Module M1273: Advanced Internship GES				
Courses				
Title	Typ Hrs/wk CP			
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous 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, w 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 engineeri tasks.			
Skills	Students of the different specialisations should be integrated in typical day's work. By this they are learning typical tasks and 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			
Autonomy	Students can finish own tasks.			
Workload in Hours	Independent Study Time 540, Study Time in Lecture 0			
Credit points	18			
Studienleistung	None			
Examination	Written elaboration (accord. to Internship Regulations)			
Examination duration and scale	I see Internship Regulations			
_	General Engineering Science (German program, 7 semester): 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.

Module M0580: Pri	inciples of Building Materials an	d Building Physics		
Courses				
Title		Typ	Hrs/wk	CP
Building Physics (L0217) Building Physics (L0219)		Lecture Recitation Section (large)	2 1	2 1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materia	als (L0215)	Lecture	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of physics, chemistry and mathe	ematics from school		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to exp different types of mechanical behaviour, to describe the structure of building materials and			terials and the nd of corrosion g materials and
Skills				
Personal Competence				
Social Competence	The students are able to support each other	to learn the very extensive spec	cialist knowl	edge.
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge a very extensive field.		st knowledge of	
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Studienleistung	,			
Examination Written exam				
Examination duration and scale	n 2 h written exam			
Assignment for the Following Curricula	General Engineering Science (Germa Engeneering: Compulsory General Engineering Science (German Compulsory Civil- and Environmental Engineering: Core General Engineering Science (English programmental Engineering Engineering Science (English programmental Engineering Engineering Engi	program, 7 semester): Special qualification: Compulsory gram): Specialisation Civil- and program, 7 semester): Special	lisation Civ	ril Engineering: al Engeneering:



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

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

Course L0247: Building Physics		
Typ 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		
Typ 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	



Madula M0740, Ot	matural Analysis				
Module M0740: Sti	ructural Analysis				
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 Knowledge	Mechanics I, Mathemati	ics I			
Educational Objectives	After taking part succes	sfully, students have reach	ed the following learning	results	
Professional Competence					
Knowledge	After successfully completing this module, students can express the basic aspects of linear fram analysis of statically determinate systems.			of linear frame	
Skills	After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.				
Personal Competence	! 				
Social Competence	<ul> <li>Students can</li> <li>participate in subject-specific and interdisciplinary discussions,</li> <li>defend their own work results in front of others</li> <li>promote the scientific development of colleagues</li> <li>Furthermore, they can give and accept professional constructive criticism</li> </ul>				
Autonomy	The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.				
Workload in Hours	Independent Study Tim	e 124, Study Time in Lectur	re 56		
Credit points	6				
	Compulsory Bonus	Form	Description		
Studienleistung	No 10 %	Written elaboration	Hausübungen Studentische Tu		
Examination	Written exam				
Examination duration and scale	90 Minuten				
	General Engineering Science (German program): Specialisation Civil- and Enviromen Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineerin Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineerin Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		ril Engineering: al Engeneering:		



Course L0666: Structural Analysis I			
Тур	Typ 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	Statically determinate structural systems  basics: statically determinacy, equilibrium, method of sections forces: determination of support reactions and internal forces influence lines of forces displacements: calculation of discrete displacements and rotations, calculation of deflection curves principle of virtual displacements and virtual forces work-engergy theorem differential equation of beam		
Literature	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.		

Course L0667: Structural Analysis I	
Тур	Recitation Section (large)
Hrs/wk	2
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: Bu	ilding Materials and Buildi	ing Chemis	stry		
Courses					
Title Building Materials and Building Building Materials and Building			Typ Lecture Recitation Section (small)	Hrs/wk 4 1	<b>CP</b> 4 2
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous Knowledge	Module Principles of Building Mater	ials and Buildi	ng Physics		
<b>Educational Objectives</b>	After taking part successfully, studer	nts have reach	ed the following learning	results	
Professional Competence					
Knowledge	The students are able to explain the most important characteristics of the testing and the fields of utilization of	e mechanical b	pehaviour and the corrosi		
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 learning groups and to carry out exe			e specialist	knowledge in
Autonomy	The students are able to make the a very extensive field.	timing and the	operation steps to learn t	the specialis	t knowledge of
Workload in Hours	Independent Study Time 110, Study	Time in Lectu	re 70		
Credit points	6				
Studienleistung	Compulsory BonusFormNo10 %Presenta	ation	Description		
Examination	Written exam				
Examination duration and scale	2 h written exam				
Assignment for the Following Curricula	General Engineering Science (General Engineering Science) Civil- and Environmental Engineering General Engineering Science (Engonpulsory	ng: Core qualif	ication: Compulsory		



Course L0248: Building	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	ourse 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, Klaus-Dieter Henk	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0706: Ge	otechnics I				
Courses					
Title		Т	ур	Hrs/wk	СР
Soil Mechanics (L0550)			ecture	2	2
Soil Mechanics (L0551)		R	ecitation Section (large)	2	2
Soil Mechanics (L1493)		R	lecitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
	Modules :				
Recommended Previous Knowledge	Mechanics I-II				
Educational Objectives	After taking part successfully, st	udents have reached	I the following learning	results	
Professional Competence					
Knowledge	The students know the basics distribution due to weight, wate failure of the soil due to ground-	er or structures, cons			
Skills	After the successful completion properties and to evaluate the stresses and deformation in the prove the usability (settlements)	em with the help of e soils due to weigh	geotechnical standard nt or influence of struct	tests. They	can calculate
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Stu	udy Time in Lecture 8	34		
Credit points	6				
Studienleistung	Compulsory Bonus Form No 20 % Attes	<b>n</b> station	Description		
Examination	Written exam				
Examination duration and scale	60 minutes				
_	General Engineering Science Engeneering: Compulsory General Engineering Science Compulsory Civil- and Environmental Engine General Engineering Science (I Compulsory General Engineering Science Compulsory Technomathematics: Specialisa	(German program, eering: Core qualifica English program): Sp (English program,	7 semester): Special ation: Compulsory pecialisation Civil- and 17 semester): Special	lisation Civ Enviromenta	il Engineering:



Course L0550: Soil Mechanics		
Тур	Lecture	
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	<ul> <li>Structure of the soil</li> <li>Ground surveying</li> <li>Compsitition and properties of the soil</li> <li>Groundwater</li> <li>One-dimensional compression</li> <li>Spreading of stresses</li> <li>Settlement calculation</li> <li>Consolidation</li> <li>Shear strength</li> <li>Earth pressure</li> <li>Slope failure</li> <li>Ground failure</li> <li>Suspension based earth tenches</li> </ul>	
Literature	<ul> <li>Vorlesungsumdruck, s. ww.tu-harburg.de/gbt</li> <li>Grabe, J. (2004): Bodenmechanik und Grundbau</li> <li>Gudehus, G. (1981): Bodenmechanik</li> <li>Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau</li> <li>Grundbau-Taschenbuch, Teil 1, aktuelle Auflage</li> </ul>	

Course L0551: Soil Mechanics	
Тур	Recitation Section (large)
Hrs/wk	2
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



Module M0613: Re	inforced Concrete I			
Courses				
<b>Title</b> Project Seminar Concrete I Reinforced Concrete Design	n I (L0303)	Typ Seminar Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 3
Reinforced Concrete Design	n I (L0305)	Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in structural analysis and buildin	g materials.		
Educational Objectives	After taking part successfully, students have reach	ed 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.			
Skills	The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.			
Personal Competence				
Social Competence				
·	The students are able to carry out simple tasks in t critically reflect the results.	he conception and dimen	sioning of s	ructures and to
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German prograt Compulsory Civil- and Environmental Engineering: Core qualif General Engineering Science (English program): Compulsory General Engineering Science (English prograt Compulsory	m, 7 semester): Special ication: Compulsory Specialisation Civil- and E	isation Civ	il Engineering:



Course L0896: Project Seminar Concrete I		
Тур	Seminar	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	In the course of the project seminar, a simple structure is drafted and dimensioned.	
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!	

Course L0303: Reinforced 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	
Content	<ul> <li>history of concrete construction</li> <li>mechanical and physical-chemical properties od concrete and steel</li> <li>bond between concrete and reinforcement</li> <li>concepts for dimensioning, limit state models, structural safety</li> <li>design of linear members for tension and bending with and without axial force</li> </ul>	
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!	

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: Sti	ructural Analysis II			
Courses				
Title		Тур	Hrs/wk CP	
Structural Analysis II (L0673	3)	Lecture	2 3	
Structural Analysis II (L0674	4)	Recitation Section (large)	2 3	
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge	- Cturretrium   Amelicaie			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional		<u> </u>		
Competence	After successful completion of this module, studently analysis of statically indeterminate systems.	dents can express the bas	sic aspects of linear	r frame
Knowledge	After successful completion of this module, the construct influence lines of statically inderminate		•	and to
Skills Personal Competence				
	Students can			
Social Competence	<ul> <li>participate in subject-specific and interdis</li> <li>defend their own work results in front of of</li> <li>promote the scientific development of coll</li> <li>Furthermore, they can give and accept pro</li> </ul>	thers leagues	cism	
Autonomy	The students are able to work in-term homework enabled to self-assess their learning progress du	_		ney are
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points				
Studienleistung	Compulsory Bonus Form  No 10 % Written elaboration	<b>Description</b> Hausübungen r Studentische Tut	mit Testat, betreut toren (Tutorium)	durch
Examination	Written exam			
Examination duration and scale	90 Minuten			
	General Engineering Science (German pr Engeneering: Compulsory	rogram): Specialisation	Civil- and Enviro	mental



	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
Assignment for the	Compulsory
Following Curricula	Civil- and Environmental Engineering: Core qualification: Compulsory
<b>3</b>	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory

Course L0673: Structural Analysis 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	<ul> <li>Linear structural analysis: statically indeterminate systems</li> <li>force method</li> <li>slope-deflection method for sway and non-sway frames</li> <li>general displacement method and finite element method</li> </ul>	
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: Ste	eel 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	<ul> <li>Structural analysis I, Structural analysis II</li> <li>Mechanics I, Mechanics II</li> <li>Building Materials and Building Chemistry</li> <li>Principles of Building Materials and Building</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
	After passing this module students are able to			
	<ul> <li>give a summary of the security concept</li> </ul>			
Knowledge	<ul> <li>explain the priciples of the design process</li> </ul>			
	<ul> <li>describe and illustrate the bhaviour of mer</li> </ul>		ion and ben	ding
	Students can rate and apply the material steel app	propiately with respect to i	ts properties	and usage.
	They can use the security concept with respect to	loads, forces and resistan	ces.	
Skills	They can check the ultimate limit state and compression and bending.	the serviceability of sin	nple membe	ers in tension,
Personal Competence				
Social Competence	After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings.			
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra Compulsory	m, 7 semester): Specia fication: Compulsory Specialisation Civil- and	lisation Civ	I Engineering:



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

Course L0300: Steel Structures I	
Тур	Recitation Section (large)
Hrs/wk	2
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: Hy	draulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Hydrology (L0909)		Lecture	1	1
Hydrology (L0956)		Project-/problem-based Learning	1	2
Hydromechanics (L0615)		Lecture	2	2
Hydromechanics (L0616)		Recitation Section (large)	1	1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
	Mathematics I, II and III			
Recommended Previous Knowledge				
	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Competence	The students are able to define the basic ter	rms of hydromechanics	and hvdrol	ogv and water
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and wate 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. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.  In addition, the basic concepts of field – measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements.			
Personal Competence				
Social Competence	The students are able to prepare and present tech	nnical presentations for giv	ven topics ir	n groups.
Autonomy	Students can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Studienleistung				
	Written exam			
	The duration of the examination is 2 hours.		with respec	ct to the general
Assignment for the Following Curricula	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qualif General Engineering Science (English program): Compulsory General Engineering Science (English program Compulsory	ogram): Specialisation m, 7 semester): Specia fication: Compulsory Specialisation Civil- and	lisation Civ	ril Engineering:



Course L0909: Hydrology	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of Hydrology:
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde

Course L0956: Hydrolog	ıy	
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:	
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde	



Course L0615: Hydromechanics		
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	<ul> <li>Characteristics of fluids</li> <li>Hydrostatics</li> <li>Kinematics of flows, laminar and turbulent flows</li> <li>Conservation laws <ul> <li>Conservation of mass</li> <li>Conservation of Energy</li> <li>Momentum Equation</li> </ul> </li> <li>Application of conservation laws to flow conditions</li> </ul>	
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



Courses				
- Title		Тур	Hrs/wk	СР
ntroduction to Control Systentroduction to Control Syste		Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	n time and frequency domain, Lapla	ace transfor	rm
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to j their controller designs	ointly solve technical problems, a	nd experim	nentally validat
Autonomy	Students can obtain information from experiment guides) and use it when solv They can assess their knowledge in wee	ing given problems.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Studienleistung				
Examination				
Examination duration and scale	120 min			



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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 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  Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course		
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



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 M0628: Wa	ater Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (LC	251)	Lecture	1	1
Groundwater Hydrology (L0	•	Recitation Section (large)	1	2
Water Management and Wa	ter Quality (L0366)	Lecture	2	3
Module Responsible	NN			
Admission Requirements	LINORE			
Recommended Previous Knowledge	Mathemaics I to III; Water Engineering I, C	hemistry		
<b>Educational Objectives</b>	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	Students are able to define terms of the hydrologic cycle and also parameters to identify the water quality. Typical aquifer types and the occurring flow and storage processes can be explained technically. They are able to derive the Darcy law and the mathematical description of flow processes as well as their solution. They are in a position to explain the physical background of well hydraulical fundamentals of solute transport can be reflected.			
Skills	Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues. They are in a position to rate water quality data and to set up hydrological water balances. They are able to construct ground water contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraulic conductivities and storage coefficients.			
Personal Competence				
Social Competence	Students are able to help each other solvi	Students are able to help each other solving case studies.		
Autonomy	Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	I ( 'IVIII - and Environmental Engineering ( 'e		lisation Civ	vil Engineering

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

**Following Curricula** 

**Elective Compulsory** 



Course L0251: Groundw	ourse 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		

ourse 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 Ma	anagement 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		



Courses					
Title	24)		<b>Typ</b> Lecture	Hrs/wk 3	CP
Computer Engineering (L032 Computer Engineering (L032			Recitation Section (small)	-	4 2
Module Responsible	Prof. Heiko Falk				
Admission	None				
Requirements		tidaal aa alaa aada a			
Recommended	The successful comple examination according to	etion of the labs will be the following rules:	e honored during the		
Previous Knowledge	marks due to the respectively, up to	e successful labs, such to the next-better grade.	that the examination's m	arks are lifte	
<b>Educational Objectives</b>	After taking part success	fully, students have reac	hed the following learning	g results	
Professional Competence					
Knowledge	combinational ne Sequential logic: Technological for Computer arithme Basics of comp pipelining Memories: Memo	ogic: Gates, Boolean atworks Flip-flops, automata, sysundations etic: Integer addition, substituter architecture: Progray hierarchies, SRAM, D from the perspective of ses computer systems from the composition of computers can be built be all composition of composition of the module, the mputer system and the ences that the execution by language down to gate	algebra, Boolean function and tematic hardware design of traction, multiplication are ramming models, MIPS RAM, caches the CPU, principles of the carchitect's perspective, uter systems. The stude ased on a collection of the explain the different are complete processors.  In the complete processors as tudents are able to just a software executed on an of software has on the ates. This way, they will	s the following sthe following stions, hardward division and single-cyc passing data i.e., they idents can analytic few and simplestraction land adde the interit. In partic hardware-ce be enabled	g topics:  vare synthesis  le architecture  a, point-to-poin  ntify the interna  yze, how highly  le components  yers of today's  erdependencies  ular, they sha  ntric abstraction  to evaluate the
Personal Competence					
Social Competence	Students are able to solv	re similar problems alone	e or in a group and to pre	sent the resu	Its 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 Lect	ure 56		
Credit points	6				
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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: 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, 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: Compute	er 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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 M0631: Co	oncrete Structures II			
Courses				
Title		Тур	Hrs/wk	СР
Project Concrete Structures	: II (I 0894)	Project Seminar	1115/WK 1	1
Concrete Structures II (L03		Lecture	2	3
Concrete Structures II (L03		Recitation Section (large)	2	2
	Prof. Günter Rombach	· · · · ·		
Admission Requirements	None			
Recommended Previous Knowledge	Lecture Concrete Structures i			
Educational Objectives	After taking part successfully, students have	reached the 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	<ul> <li>The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.).</li> <li>The students can estimate the member forces of simple slabs.</li> <li>The students know the content and the layout of a structural analysis</li> </ul>			
Personal Competence				
Social Competence	Cooperation in a project work where they	design in a team a real concre	te building a	and present the
Autonomy	1			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	l			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	1120 minutes			
Assignment for the Following Curricula	General Engineering Science (German Engeneering: Compulsory General Engineering Science (German p Elective Compulsory	orogram, 7 semester): Special qualification: Compulsory gram): Specialisation Civil- and	llisation Civ	il Engineering:

Elective Compulsory



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

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

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



Module M0755: Ge	otechnics II			
Courses				
Title		Тур	Hrs/wk	СР
Foundation Engineering (L05	,	Lecture	2	2
Foundation Engineering (L05		Recitation Section (large)	2	2
Foundation Engineering (L14	494)	Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
	Modules:			
Recommended Previous Knowledge	<ul><li>Mechanics I-II</li><li>Geotechnics I</li></ul>			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	The students know the basic principles and metageotechnical structures.	hods which are required	to verificate	the stability of
Skills	After successful completion of the module the students are able to:  • verificate the stability and usability of foundations,  • know individual methods of ground improvement and apply them in their range of application,  • design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core qualif General Engineering Science (English program): Compulsory General Engineering Science (English program Elective Compulsory Technomathematics: Specialisation III. Engineering	fication: Compulsory Specialisation Civil- and I	lisation Civi Enviromenta Iisation Civi	I Engineering:



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

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

Course L1494: Foundation Engineering	
Тур	Recitation Section (small)
Hrs/wk	2
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 M0878: Applications in Civil and Environmental Engineering

Module Moore. Ap		- Innertal Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Applied Numerical Methods	(L0211)	Seminar	3	3
Applied Structural Dynamics	(L0791)	Lecture	2	2
Building Information Modeling	g (L1903)	Lecture	1	1
Building Information Modeling	g (L1904)	Project-/problem-based Learning	2	2
Computational Analysis of S	tructures (L0370)	Lecture	2	3
Introduction in Statitics with	R (L0286)	Lecture	1	1
Introduction in Statitics with	R (L0776)	Recitation Section (large)	1	1
Principles of Geomatics (L04	470)	Lecture	2	2
Principles of Geomatics (L04	471)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)		Practical Course	2	2
Practical Course in Drinking		Practical Course	1	2
Projects II (L1228)	, ,	Project Seminar	2	2
Fire Protection and Preventi	on (L0472)	Lecture	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence	<del></del>	0 0		
Knowledge	The students are at home doing with typical applications of the study programme.			
	The students are able to use the methods that are provided during the lectures for practical questions. They are able to work in the learnt methods into new forms of application independently".			
Skills				
Personal Competence				
Social Competence	According to the course chosen students are able to perform tasks or to conduct a project in teams. I so, they can present, discuss and document results accordingly.			
Autonomy	According to the course chosen individual students can plan and document tasks and work flow for themselves or for the team.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the Following Curricula	General Engineering Science (Germa Elective Compulsory Civil- and Environmental Engineering: C General Engineering Science (Englis	Core qualification: Compulsory		-

**Elective Compulsory** 





Course L0791: Applied S	Structural 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 scale	15 min
Lecturer	Dr. Kira Holtzendorff
Language	DE
Cycle	WiSe
Content	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	Information 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 scale	siehe Modulhandbuch
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe/SoSe
Content	Designing of basic drawing elements (e. g. line, circle, arc,)  Modifying of construction elements (e. g. copy, mirror, extend, trim, fillet,)  Administration and use of the program structure  Dimensioning of design and structural elements  Inscribing of design and structural elements  Hatching of structural elements  Creating and preparing of printable drawings  Aims and procedure of building information modeling
Literature	-

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	
	Schriftliche Ausarbeitung	
Examination duration and scale	siehe Modulhandbuch	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



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



Course L0286: Introduct	ion in Statitics with R		
Тур	Lecture		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Examination Form	Klausur		
Examination duration and scale	60 min		
Lecturer	Dr. Joachim Behrendt		
Language	DE		
Cycle	WiSe		
	Introduction to R		
	Graphics with R		
	Descriptive Statistic (Boxplot, Percentiles, outliers)		
	Propability (Combinatorics, relative frequency, dependand probability)		
Content	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)		
	Introduction time series (tseries)		
	Introduction cluster analysis (k-means)		
	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		
Literature	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.fuberlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fuberlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf		



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		
Examination duration and scale	siehe Vorlesung	
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 scale	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur		
Lecturer	Prof. Peter Andree		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Overview of geomatics in general</li> <li>Units of measurements</li> <li>Generating of topographical maps</li> <li>Basic surveying instruments and handling</li> <li>Geodetic surveying lines and verification of measurements</li> <li>Methods of horizontal survey</li> <li>Components of geodetic surveying instruments</li> <li>Height determination</li> <li>Setting out points</li> <li>Topographical survey</li> <li>Directions and angles</li> <li>Determination of coordinates</li> <li>Traversing</li> <li>Basics on surveying and positioning with GNSS</li> </ul>		
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 scale	5 Übungsaufgaben jeweils mit Testat am Ende		
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter		
Language	DE		
Cycle	SoSe		
Content	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>		
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	
	Fachtheoretisch-fachpraktische Arbeit	
Examination duration and scale	6 Versuchsprotokolle	
Lecturer	Dr. Klaus Johannsen	
Language	DE	
Cycle	WiSe	
Content	IMax.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 5. Day: Evaluation of the protocols	
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		
Examination duration	ca. zehnminütige Präsentation	
and scale	Sa. 25mmmaago 1 1aosmaasii	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	Excursions to different construction and enviromental 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		
	Mündliche Prüfung		
Examination duration and scale	20 min		
Lecturer	Andreas Kattge		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction</li> <li>fire in residential and office buildings</li> <li>town planning: location of residential, office and industry areas, location of fire stations</li> <li>design of roads an water pipes</li> <li>explosions</li> </ul>		
Literature	Schneider U.: Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002		



Module M0829: Fo	undations of Management			
Courses				
Title Management Tutorial (L088) Introduction to Management		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	I Racic Knowiadda of Wathamatice and Rijcina	SS		
	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	After taking this module, students know the in Management, from Planning and Organisation and Controlling. In particular they are able to	on to Marketing and Innovati	on, and als	o to Investmen
Knowledge	<ul> <li>explain the differences between Ec Management and to name important of explain the most important aspects of aspects of entreprneurial projects</li> <li>describe and explain basic business supply chain management, organized management, innovation management explain the relevance of planning an multiple objectives and uncertainty, Finance</li> <li>state basics from accounting and costi</li> </ul>	efinitions from the field of Mar and goals in Management ar s functions as production, p ation and human ressource t and marketing d decision making in Busine and explain some basic m	nagement and name the procurement management ss, esp. in sethods from	most important and sourcing ent, information
Skills	Students are able to analyse business units strategies etc.) and to carry out an Entreprene   analyse Management goals and struct analyse organisational and staff struct apply methods for decision making un analyse production and procurement analyse and apply basic methods of meselect and apply basic methods from apply basic methods from apply basic methods from accounting,	urship project in a team. In parture them appropriately ures of companies der multiple objectives, under systems and Business informatarketing nathematical finance to prede	uncertainty tion system	y are able to and under risk s ms
Personal Competence				
Social Competence	work successfully in a team of student:     to apply their knowledge from the lec report on the project     to communicate appropriately and     to cooperate respectfully with their feller	ture to an entrepreneurship p	roject and v	vrite a coheren
Autonomy	Students are able to  work in a team and to organize the tea  to write a report on their project.	m themselves		
	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



## and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

Compulsory

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek	
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 self-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.	



ırse L0880: Introduct	ion to Management				
	Lecture				
Hrs/wk	3				
СР	3				
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona				
Language	DE				
Cycle	WiSe/SoSe				
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>				
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.  Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.  Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.  Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: St	ructural Design				
Courses					
Title Basics of Structural Design Exercises in Structural Design Seminar in Structural Design	ign (L0208)		Typ Lecture Recitation Section (large) Project-/problem-based	Hrs/wk 2 1	<b>CP</b> 1 1
			Learning		
Admission Requirements	INone				
Recommended Previous Knowledge		ciples of Building Materia	als and Building Physics"		
<b>Educational Objectives</b>	After taking part successf	fully, students have reach	ed the following learning	results	
Professional Competence		and decide an older			
Knowledge	<ul><li>to specify typical t</li><li>to distinguish diffe</li></ul>	cs of building regulations building components	law bearing behaviour and ris	sks due to la	ck of stability
Skills	After attending the course students are able  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 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	After attending the course	e students are able			
Social Competence	<ul><li>to work in a team</li><li>to use the feedba</li></ul>	and to persent the results ck from other students to k to other students in a co	improve the own results		
Autonomy	and tests (STUD.I	prove their knowledge w P) n task in different parts, to	ith the help of weeekly p deduce the needed know		
Workload in Hours	Independent Study Time	110, Study Time in Lectu	re 70		
Credit points	6				
Studienleistung	Yes 20 %	Form Written elaboration	<b>Description</b> Erarbeiten eines Ausführungsplar 4 Personen	_	
Examination	Written exam				
Examination duration and scale	160 minutes written test				
Assignment for the	Compulsory	cience (German progra	m, 7 semester): Specia	lisation Civ	il Engineering



Following Curricula	Civil- and	d Environment	al Engine	ering: Co	re qualifica	ıtio	n: Compulso	ory		
	General	Engineering	Science	(English	program,	7	semester):	Specialisation	Civil	Engineering:
	Compuls	ory								

	f Structural Design
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Gernod Deckelmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics of building regulation laws</li> <li>Foundation of buildings</li> <li>Sealing of basements</li> <li>facades</li> <li>Ceilings</li> <li>Roofs</li> <li>Windows, doors and post-and-beam constructions</li> <li>Staircases</li> <li>Basics of strucural engineering design</li> <li>Structural fire prevention</li> <li>Optional tests on STUD.IP</li> </ul>
Literature	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, Wänd 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, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Mund Ziel; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernend ISBN: 978-3-8348-0732-8 (GB.)



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



ourse L0209: Seminar	in Structural Design			
Tvp	Project-/problem-based Learning			
Hrs/wk				
СР				
	Independent Study Time 92, Study Time in Lecture 28			
	Dr. Gernod Deckelmann			
Language	DE			
Cycle				
Content	<ul> <li>Constructing a small individuell building in groups of 4 persons</li> <li>Analysing the informations and the contents of development plans and building regulation laws</li> <li>Design of building components and approving of the funcionality (sealing, facades, roofs)</li> <li>Design and approve of the funcionality of the component interconnections</li> <li>Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control</li> <li>Assessing the building stabilty</li> <li>Basics of building services</li> <li>Each week the results of different work steps are presented in oral and written form</li> </ul>			
Literature	Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden: B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006 Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008  Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion: [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied: Werner, 2007  Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure: mit Berechnungshinweisen und Beispielen; [auf CD-ROM: Stabwerksprogramm IO 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied: Werner, 2006  Wendehorst, Reinhard (Wetzell, Otto W.,; Baumgartner, Herwig.; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.]: Teubner Berlin [u.a.]: Beuth, 2007  Neufert, Ernst (Kister, Johannes) Bauentwurfslehre: Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße 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: Sa	nitary Engineering			
Courses				
Title Wastewater Disposal (L027 Wastewater Disposal (L027 Drinking Water Supply (L03) Drinking Water Supply (L03)	8) 06)	Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	<b>CP</b> 2 1 1 2
		ricolation occiton (large)	'	
Module Responsible Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge on Chemistry and Biology</li> <li>Hydraulics of pipe systems and open channels</li> <li>Basic knowledge on water management: water quantity and water quality</li> <li>Basic knowledge on Environmental Legislation: Federal Water Act</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems in Germany and they are capable of reproducing the relevant empiricals assumptions and scientific simplifications. The students are able to present and discuss sanitary engineering processes and the technologies used for drinking and wastewater treatment. They can also assess existing problems in the field of sanitary engineering by considering legal, risk and saftey aspects. Furthermore, they know how to draft the features and effectiveness of important technologies of the future such as high- and low-pressure membrane filtration systems and techniques for the removal of trace pollutants.			
Skills	The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence  Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are able to form concepts on their Therefore they can acquire appropriate know regard to the approach to problems (preparate	vledge when being given son	ne clues or	
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale				
	General Engineering Science (German Engeneering: Compulsory	program): Specialisation	Civil- and	l Enviromenta



	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
Assignment for the	Elective Compulsory
Following Curricula	Civil- and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Elective Compulsory

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

Course L0278: Wastewater Disposal		
Тур	Recitation Section (large)	
Hrs/wk	1	
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
	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).
Content	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.
	Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag.
	Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag
Literature	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: Hy	draulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L095 Hydraulic Engineering (L096	•	Lecture Recitation Section (large)	2	2 2
	, 	necitation Section (large)	1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Hydraulik Engineering I			
Educational Objectives	After taking part successfully, students have reach	hed the following learning	results	
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can 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 practical problems and design respective hydraulic engineering systems. Besides this, they are able to use and apply established approaches of hydraulics and determine water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system.		able to use and lows, influences	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionally, they will be		naly, they will be	
Autonomy	The students will be able to independently extend	d their knowledge and app	ly it to new	problems.
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
	The duration of the examination is 2 hours. The eunderstanding of the lecture contents and calcula		with respe	ct to the general
Assignment for the Following Curricula	General Engineering Science (German pr Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core qual General Engineering Science (English program): Compulsory General Engineering Science (English program)	am, 7 semester): Specia ification: Compulsory : Specialisation Civil- and	lisation Civ	vil Engineering: al Engeneering:

Elective Compulsory



Course L0957: Hydraulics		
Тур	Typ 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: Hydraulio	Course L0959: Hydraulic Engineering	
	Lecture	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Inland waterways engineering</li> <li>waterways</li> <li>Locks and ship lifts</li> <li>Fish passages</li> <li>Nature-oriented hydraulic engineering</li> </ul>	
Literature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011	

Course L0960: Hydraulie	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.

Courses				
Title	orionavira (Diagrama and English and and (1.0000)	Тур	Hrs/wk	CP
Introduction into Process Er Fundamentals of material er	ngineering/Bioprocess Engineering (L0829) ngineering (L0830)	Lecture Lecture	2 2	1 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements				
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have	reached the following le	earning results	
Professional Competence	After passing this module the students have			
Knowledge	<ul> <li>give an overview of the most imports</li> <li>explain some working methods for one</li> </ul>			eering,
Skills	After passing this module the students shou     Itist and outline the most important fire     name the most important working engineering,     read and prepare an engineering dresplain the most important technolo scheme typical chemical and bid pointers.	elds of process engineer approaches or method awing, gies for wastewater and	s of the different fi	ent
Personal Competence	The students are able to			
Social Competence	<ul> <li>work out results in groups and docu</li> <li>provide appropriate feedback and h</li> </ul>		own performance o	constructively.



Autonomy	The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering.		
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56		
Credit points	3		
Studienleistung	Compulsory Bonus Form Description Yes None Written elaboration		
Examination	Written exam		
Examination duration and scale	190 min		
_	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Compulsory Process Engineering: Compulsory		

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



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



Courses				
Title		Тур	Hrs/wk	СР
Physical Chemistry (L0833)		Lecture	2	2
Physical Chemistry (L0835)		Practical Course	2	1
	Prof. Hans-Ulrich Moritz			
Admission Requirements	None			
Recommended Previous Knowledge	Contents of the previous modules inorganic	c chemistry, physics for eng	ineers and math	ematics I-III.
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following lear	ning results	
Professional Competence				
	The students are able,			
	-to repeat the basic concepts of physical ch	emistry		
Knowledge	-to describe and summarize the underlying	concepts of mass-, heat- a	nd momentum tr	ansfer.
	- to interpret phase diagrams and affiliate k	inetic rate laws.		
	The students are able to			
	- conduct (fundamental) thermodynamical,	electrochemical and kinetic	calculations.	
Skills	s - assess new applications with respect to environmental sustainability.			
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kineticalculations.			
Personal Competence				
·	The students are able to plan, prepare, or guidelines in small groups.	conduct and document exp	eriments accord	ling to scienti
Social Competence	The students are able to reflect their subjection fellow students and faculty.	ct-specific knowledge orally	in a team and t	o discuss it w
Autonomy	Students are able to assess their knowldege continuously on their own by exemplified practice Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.			
Workload in Hours	Independent Study Time 34, Study Time in	Lecture 56		
Credit points				
Studienleistung	Compulsory Bonus Form Subject the	<b>Descriptio</b> pretical and	n	
Studienielstung	Yes None Subject the practical work	oretical and		
Examination	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulso General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Compulsory			



Elective Compulsory
Process Engineering: Core qualification: Compulsory

Course I 0022. Physical Chemistry			
Course L0833: Physical Chemistry			
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	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>		



Course L0	835: 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
	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
Content	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.
	Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter
Literature	http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Courses					
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032			Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge	examination according t  1. Upon a passed marks due to the respectively, up t	etion of the labs will to the following rules:  module examination e successful labs, su to the next-better grad	I be honored during the of the student is granted a back that the examination's made.	oonus on the arks are lifte	e examination'
<b>Educational Objectives</b>	After taking part success	sfully, students have re	eached the following learning	g results	
Professional Competence					
Knowledge	This module deals with from the assembly-level  Introduction Combinational combinational need to sequential logic: Technological foed to Computer arithm Basics of compipelining Memories:	logic: Gates, Booles etworks : Flip-flops, automata, undations retic: Integer addition, outer architecture: Fory hierarchies, SRAM from the perspective sees computer systems from cal composition of computers can be buinguish between and m gates and circuits unterpretation of the module, omputer system and unences that the executive language down to	e functionality of computing a gates. The module includes an algebra, Boolean functions systematic hardware design subtraction, multiplication and trogramming models, MIPS and the CPU, principles of the CPU, principles of the architect's perspective, mputer systems. The students based on a collection of for the explain the different allow to complete processors. The students are able to just the software executed on the software executed on the gates. This way, they will we on an entire system's perspective, and the software system's perspective, and the software that the software that the software has on the software and the system's perspective, and the software system's perspective, and the software that the software th	tions, hardy ad division a single-cyc passing data i.e., they ide ats can analy ew and simp betraction la adge the inte it. In partic hardware-ce be enabled	g topics:  vare synthesis  le architecture  a, point-to-poin  ntify the interna  yze, how highly  le components  yers of today's  erdependencies  ular, they sha  ntric abstraction  to evaluate the
Personal Competence	feasible options.				
Social Competence	Students are able to solv	ve similar problems al	one or in a group and to pres	sent the resu	lts accordingly.
		quire new knowledge	from specific literature and	to associate	this knowledge
Workload in Hours	I Independent Study Time	e 124, Study Time in L	ecture 56		
Credit points	<u> </u>	·			
	Compulsory Bonus	Form	Description		



General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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
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 Theoretical Mechanical Engineering: Compulsory
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General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Focus Product Development and Production: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory
Assignment for the Following Curricula General Engineering Science (English program): Core qualification: Compulsory  Following Curricula 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: Compute	r Engineering		
Тур	Lecture		
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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer 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							
Title		Тур	Hrs/wk	СР			
Fundamentals of Fluid Mechanics (L0091) Fluid Mechanics for Process Engineering (L0092)			Lecture Recitation Section (large)	2 2	4 2		
Module Responsible	Prof. Michael Schlüter	Prof. Michael Schlüter					
Admission Requirements	None						
Recommended Previous Knowledge	<ul> <li>Mathematics I+II+III</li> <li>Technical Mechanics I+II</li> <li>Technical Thermodynamics I+II</li> <li>Working with force balances</li> <li>Simplification and solving of partial differential equations</li> <li>Integration</li> </ul>						
Educational Objectives	After taking part success	fully, students have	e reached the following learning	results			
Professional Competence							
Knowledge	<ul> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in process engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions</li> </ul>						
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>						
Personal Competence							
Social Competence	<ul> <li>are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and</li> <li>able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)</li> <li>are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results.</li> </ul>						
Autonomy	The students are able to  • search further literature for each topic and to expand their knowledge with this literature,  • work on their exercises by their own and to evaluate their actual knowledge with the feedback.						
Workload in Hours	Independent Study Time	124, Study Time i	Lecture 56				
Credit points	6						
Studienleistung	Compulsory Bonus Form Description Yes 5 % Midterm						
Examination	Written exam						
Examination duration and scale	O barre						



	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory			
Assignment for the Following Curricula	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental			
	Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:			
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
General Engineering Science (English program, 7 semester): Specialisation Energy at Engineering: Compulsory				
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory  Process Engineering: Core qualification: Compulsory			

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



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



Courses				
Title Phase Equilibria Thermodynamics (L0114) Phase Equilibria Thermodynamics (L0140) Phase Equilibria Thermodynamics (L0142)		<b>Typ</b> Lecture Recitation Section (so Recitation Section (la		<b>CP</b> 2 2 2
Module Responsible			.90)	_
Admission Requirements				
Recommended Previous Knowledge	Mathematics, Physical Chemistry, The	modynamics I and II		
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lea	rning results	
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria.</li> <li>They learn how state variables are influenced by the mixing of compounds and learn concept to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibrium Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	<ul> <li>Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how to simplify these equations meaningfully</li> <li>The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve the resulting mathematical relations.</li> <li>For specific applications, they are able to self-reliantly find necessary physico-chemic properties of compounds as well as model parameters in literature sources.</li> <li>Beside pure compound properties the students are capable of describing the properties mixtures.</li> <li>The students know how to visualize phase equilibria graphically and they know how interpret the occurring phenomena.</li> <li>Based on their knowledge, the students are able to understand fundamental concepts that a the basis for many separation and reaction processes in chemical engineering.</li> </ul>			
Personal Competence		Il groups to colus the correspon	anding problem	and to proce
Social Competence	The students are able to work in sma them oraly to the tutors and other stude		onaing problems	ь ани ю prese
Autonomy	<ul> <li>The students are able to find necessary information self-reliantly in literature sources and t judge their quality.</li> <li>During the semester the students are able to check their learning progress continuously i exercises. Based on this knowledge the students can adept their learning process.</li> </ul>			
Workload in Hours				



Credit points Studienleistung	Rone
Examination	Written exam
Examination duration and scale	I 120 minutes: ineoretical questions and calculations
_	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Compulsory Compulso

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



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



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



Module M0757: Bio	ochemistry and Microbiology					
Courses						
Title		Тур	Hrs/wk	СР		
Biochemistry (L0351)		Lecture	2	2		
Biochemistry (L0728)		Project-/problem-based Learning	1	1		
Microbiology (L0881)		Lecture	2	2		
Microbiology (L0888)		Project-/problem-based Learning	1	1		
Module Responsible	Dr. Paul Bubenheim					
Admission Requirements	None					
Recommended Previous Knowledge	none					
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results			
Professional Competence						
23	At the end of this module the students can:					
	- explain the methods of biological and biod biomolecules	chemical research to de	etermine the	e properties of		
	- name the basic components of a living organism	1				
Knowledge	- 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					
Social Competence	- to introduce their own knowledge and to argue their view in discussions in teams					
	- to divide a complex task into subtasks, solve these and to present the combined results					
Autonomy	The students are able to present the results of the	ir subtasks in a written rep	oort			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Studienleistung	None					
	Written exam					
Examination duration and scale	90 min					
	General Engineering Science (German program): General Engineering Science (German program, Compulsory Bioprocess Engineering: Core qualification: Comp General Engineering Science (English program): General Engineering Science (English program, Compulsory Technomathematics: Specialisation III. Engineerin	7 semester): Specialisation pulsory Specialisation Bioproces: 7 semester): Specialisation	on Bioproce s Engineerir on Bioproce	ss Engineering:		



Course L0351: Biochem	istry
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	<ol> <li>The molecular logic of Life</li> <li>Biomolecules:         <ol> <li>Amino acids, peptides, proteins</li> <li>Carbohydrates</li> <li>Lipids</li> </ol> </li> <li>Protein functions, Enzymes:         <ol> <li>Michaelis-Menten kinetics</li> <li>Enzyme regulation</li> <li>Enzyme nomenclature</li> </ol> </li> <li>Cofactors and cosubstrates, vitamines</li> <li>Metabolism:         <ol> <li>Basic principles</li> <li>Photosynthesis</li> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Respiration</li> <li>Anaerobic respirations</li> <li>Fatty acid metabolism</li> </ol> </li> <li>Amino acid metabolism</li> </ol>
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: Biochem	istry		
Тур	Project-/problem-based Learning		
Hrs/wk			
СР			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Paul Bubenheim		
Language	DE		
Cycle	SoSe		
Content	<ol> <li>The molecular logic of Life</li> <li>Biomolecules:         <ol> <li>Amino acids, peptides, proteins</li> <li>Carbohydrates</li> <li>Lipids</li> </ol> </li> <li>Protein functions, Enzymes:         <ol> <li>Michaelis-Menten kinetics</li> <li>Enzyme regulation</li> <li>Enzyme nomenclature</li> </ol> </li> <li>Cofactors and cosubstrates, vitamines</li> <li>Metabolism:         <ol> <li>Basic principles</li> <li>Photosynthesis</li> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Respiration</li> <li>Anaerobic respirations</li> <li>Fatty acid metabolism</li> </ol> </li> <li>Amino acid metabolism</li> </ol>		
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: Microbiol	ogy		
Тур	Lecture		
Hrs/wk	2		
СР			
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	<ul> <li>Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)</li> <li>Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €)</li> <li>Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag</li> <li>Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/</li> </ul>		



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



Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L043)		Lecture	3	4
Signals and Systems (L043)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace tr	xpected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.			
Skills	The students are able to describe and analy using methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal properties.	r. They can analyse and design the stability, line	ın basic sys earity etc T	tems regardin
Personal Competence				
Social Competence	The students can jointly solve specific proble			
Autonomy	The students are able to acquire relevant i control their level of knowledge during the I clicker system.			-
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory	ram): Specialisation Computer ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation program, Specialisation Biomedica gram, 7 semester): Specialisation program, 7 semester): Specialisatio	Science: Congineering: s Engineering: s Engineering: Civil- and Mechanica al Engineerition Electrical sation Contation Procession	Compulsory Compulsory ng: Compulsor Enviromenta  I Engineering ng: Compulsor al Engineering nputer Science as Engineering



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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 M0938: Bio	oprocess Engineer	ing - Fundame	entals		
Courses					
Title Bioprocess Engineering - Fu Bioprocess Engineering- Fu	` '	10042)	Typ Lecture Recitation Section (large		<b>CP</b> 3 1 2
Module Responsible	1	L0843)	Practical Course	2	2
Admission Requirements					
Recommended Previous Knowledge	i none modille "ordanic ch	emistry", module "fu	undamentals for process er	ngineering"	
Educational Objectives	After taking part successfu	ılly, students have ı	eached the following learn	ing results	
Professional Competence					
Knowledge	Students are able to desc different types of kinetics inhibition. The parameters in bioreactors can be e management, sterilization	for enzymes and m s of stoichiometry a xplained. The stu technology and do	cepts of bioprocess engine icroorganisms, as well as the relation of the common dents are capable to expensive amprocessing in description.	o differentiate of and mass tran plain fundame	different types of sport processes
Skills	<ul> <li>After successful completion of this module, students should be able to</li> <li>describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters</li> <li>predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process</li> <li>analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations</li> <li>distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem</li> <li>propose solutions to complicated biotechnological problems and to deduce the corresponding models</li> <li>to explore new knowledge resources and to apply the newly gained contents</li> <li>identify scientific problems with concrete industrial use and to formulate solutions.</li> <li>to document and discuss their procedures as well as results in a scientific manner</li> </ul>				
Personal Competence		aadula maytisinaate		a taabaigal ay	aatiana in amall
Social Competence	-	oility to take position	s should be able to debat on to their own opinions a onments.	•	
Autonomy	•		s will be able to solve a nd to present their results	-	olem in a team
Workload in Hours	Independent Study Time 9	96, Study Time in L	ecture 84		
Credit points	6				
Studienleistung	Yes None	Form Subject theore practical work	<b>Description</b> etical and		
Examination	Written exam				
Examination duration and scale	90 min				
	General Engineering Scie	nce (German prog	ram): Specialisation Proces ram): Specialisation Biopro gram, 7 semester): Specia	cess Engineeri	ng: Compulsory



	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: 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
	Process Engineering: Core qualification: Compulsory

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



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	<ol> <li>Introduction (Prof. Liese, Prof. Zeng)</li> <li>Enzymatic kinetics (Prof. Liese)</li> <li>Stoichiometry I + II (Prof. Liese)</li> <li>Microbial Kinetics I+II (Prof. Zeng)</li> <li>Rheology (Prof. Liese)</li> <li>Mass transfer in bioprocess (Prof. Zeng)</li> <li>Continuous culture (Chemostat) (Prof. Zeng)</li> <li>Sterilisation (Prof. Zeng)</li> <li>Downstream processing (Prof. Liese)</li> <li>Repetition (Reserve) (Prof. Liese, Prof. Zeng)</li> </ol>	
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	



Courses					
Title  Heat and Mass Transfer (Li  Heat and Mass Transfer (Li  Heat and Mass Transfer (Li	0102)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	<b>CP</b> 2 2 2	
Module Responsible	, !	necitation Section (large)	1	2	
Admission Requirements					
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynar	nics			
<b>Educational Objectives</b>	After taking part successfully, students hav	re reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchanger, chemical reactors).</li> <li>They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation.</li> <li>The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories.</li> <li>They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail.</li> </ul>				
Skills	<ul> <li>The students are able to set reasonable system boundaries for a given transport problem busing the gained knowledge and to balance the corresponding energy and mass flow respectively.</li> <li>They are capable to solve specific heat transfer problems (e.g. heated chemical reactors temperature alteration in fluids) and to calculate the corresponding heat flows.</li> <li>Using dimensionless quantities, the students can execute scaling up of technical processes of apparatus.</li> <li>They are able to distinguish between diffusion, convective mass transition and mass transfer They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column).</li> <li>In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages respectively.</li> <li>In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus.</li> <li>The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems.</li> </ul>				
Personal Competence  Social Competence	The students are capable to work  rocults orally in a reasonable many		in teams an	d to present the	
	The students are able to find and e They are able to prove their leprocedure continuously (clicker-sy	vel of knowledge during the	course with	accompanying	



Autonomy	control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Studienleistung	
	Written exam
Examination duration and scale	120 minutes; theoretical questions and calculations
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory 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  2. 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	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>

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		



Courses					
Title Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141)		Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 2 1	
Separation Processes (L115	,	Practical Course	1	1	
Module Responsible  Admission					
Requirements	None				
Recommended Previous Knowledge	Recommended requirements: Thermodyn	amics III			
<b>Educational Objectives</b>	After taking part successfully, students have	re reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>The students can distinguish and describe different types of separation processes such a distillation, extraction, and adsorption</li> <li>The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems</li> <li>They have good knowledge of designing methods for separation processes and devices</li> </ul>				
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a give separation process and can close the associated energy and material balances</li> <li>The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required</li> <li>They can select and design a basic type of thermal separation process for a given case base on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties for appropriate sources (diagrams and tables)</li> <li>They can calculate continuous and discontinuous processes</li> <li>The students are able to prove their theoretical knowledge in the experimental lab work.</li> <li>The students are able to discuss the theoretical background and the content of experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and it together for the solution of technical problems. Other lectures such as thermodynamics, fl mechanics and chemical engineering.</li> </ul>				
Personal Competence	The students can work technical results in the tutorial	assignments in small groups a	and presen	t the combine	
Social Competence	<ul> <li>The students are able to carry out practical lab work in small groups and organize a functional division of labor between them. They are able to discuss their results and to document then scientifically in a report.</li> </ul>				
Autonomy	<ul> <li>The students are capable to o themselves and assess their qualit</li> <li>The students can proof the state o this way control their learning proc</li> </ul>	y f their knowledge with exam rese			



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Studienleistung	None
Examination	Written exam
Examination duration and scale	I 120 minutes: theoretical questions and calculations
Assignment for the Following Curricula	



Tvp	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	
Cycle	
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 37985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technische Chemie</li> </ul>



ırse L0119: Thermal	Separation Processes				
Тур	Recitation Section (small)				
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	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul> The students work on tasks in small groups and present their results in front of all students.				
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 37985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>				



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



Course L1159: Separation	on Processes				
Тур	Practical Course				
Hrs/wk	1				
СР	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Irina Smirnova				
Language	DE/EN				
Cycle	GoSe				
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.  The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.  Topics of the practical course:  Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes				
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>				



Module M0892: Ch	nemical Reaction E	ngineering	g				
Courses							
Title				Тур	Hrs/wk	СР	
	ring (Fundamentals) (L0204)			Lecture	2	2	
	ring (Fundamentals) (L0244) ical Engineering (Fundamenta	als) (I 0221)		Recitation Section (large) Practical Course	2	2	
Module Responsible		210) (20221)		Tradition Course			
Admission							
Requirements	INIONO						
	Contents of the previous as well as computational			I, physical chemistry, ted	chnical ther	modynamics I+I	
Educational Objectives	After taking part successf	ully, students l	have reache	ed the following learning	results		
Professional Competence							
Knowledge	The students are able to point out differences bet ability to outline parts of i	ween thermod	lynamical ai	nd kinetical processes.	The student	s have a strong	
	After successful completi	on of the modu	ule, students	s are able to:			
	- apply different computa	tional methods	s to dimensi	on isothermal and non-is	sothermal id	eal reactors,	
Skills	- determine and compute	stable operati	ion points fo	r these reactors,			
	- conduct experiments guidelines.	- conduct experiments on a lab-scale pilot plants and document these according to scientifiguidelines.					
Personal Competence							
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers.						
Autonomy	The students are able to can apply their knowldeg					nously. Students	
Workload in Hours	Independent Study Time	96, Study Time	e in Lecture	84			
Credit points	6						
Studienleistung	Compulsory Bonus Yes None	Form Subject practical wo	theoretical	<b>Description</b> and			
Evamination	Written exam	practical we					
Examination duration and scale	<u></u>						
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory						

Course L0204: Chemical Reaction Engineering (Fundamentals)	
Typ Lecture	

Process Engineering: Core qualification: Compulsory

Compulsory



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

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, massconcentration, 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, elementspecies-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, Damköhlernumber, differential and integral method of kinetic analysis, laboratory reactors for kinetic Content 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, molebalance 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)

lecture notes Raimund Horn

skript Frerich Keil

Books:



M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Che	mie,
Wiley-VCH	

G. Emig, E. Klemm, Technische Chemie, Springer

Literature

- 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

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



## Content

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, molebalance 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)

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

## Literature

- 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



ourse L0221: Experim	ental 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 M0945: Bioprocess Engineering - Advanced				
Courses				
Title Bioprocess Engineering - Ac Bioprocess Engineering - Ac		Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 2	<b>CP</b> 4 2
Module Responsible	Prof. An-Ping Zeng			
Admission Requirements				
Recommended Previous Knowledge	Content of module "Biochemical Engineering I"			
	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	After successful completion of this module, stude	ents should be able to		
	<ul> <li>describe and explain different kinetic app</li> </ul>	roaches for growth and sul	bstrate-upta	ke
Knowledge	identification of scientific problems with and mammalian cells)	concrete industrial use (cu	ıltivation of r	microorganisms
	describe and explain important downstruated as basic immobilization methods	eaming steps for proteins a	and their app	olication as well
	After successful completion of this module, stude	ents should be able to		
	<ul> <li>to identifiy scientific questions or possible prac cultivation of microorganisms and animal cells)</li> </ul>			applications (eg
	- To assess the application of scale-up criteria f apply these criteria to given problems (anaerobic		-	ocesses and to
	- to formulate questions for the analysis ar processes appropriate solutions ,	d optimization of real b	iotechnolog	ical production
Skills	- To describe the effects of the energy generation growth inhibition of the behavior of microorganis	on, the regeneration of redums and to the total ferment	uction equivation proces	alents , and the s qualitatively
	- Establish material flow balance equations an different approaches and to calculate immobilization		e the kinetio	parameters of
	- to select process control strategies (batch , fe basic types and evaluate them.	ed-batch, continuity) app	ropriately ar	nd to calculate
Personal Competence				
Social Competence	After completion of this module participants shaems to enhance the ability to take position t teamwork.			
Autonomy	After completion of this module participants are their knowledge to previously unknown issues a		es of knowle	edge and apply
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Studienleistung	None			



	Written exam
Examination duration and scale	90 min
	repetal Engineering Science (English program). Specialisation Bioprocess Engineering, Compilisory i



ourse L1108: Bioprocess Engineering - Advanced			
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. An-Ping Zeng, Prof. Andreas Liese		
Language	DE		
Cycle	<u>WiSe</u>		
Content	<ul> <li>Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture</li> <li>Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese)</li> <li>Enzymatic process II (Prof. Liese)</li> <li>Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese)</li> <li>Anaerobic fermentation processes (Prof. Zeng)</li> <li>Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng)</li> <li>Fedbatch process and cultivation with high cell density (Prof. Zeng)</li> <li>Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese)</li> <li>Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng)</li> <li>Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng)</li> <li>The students present exercises and discuss them with their fellow students and faculty statt. In the PBL part of the class the students discuss scientific questions in teams. They acquire knowledge and apply it to unknown questions, present their results and argue their opinions.</li> </ul>		
Literature	K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012  H. Chmiel: Bioprozeßtechnik, Elsevier, 2006  R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010  H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997  P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013  Skripte für die Vorlesung		



ns (L0654) ns (L0655) Prof. Herbert Werner None Representation of signals and systems in	Typ Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Prof. Herbert Werner  None  Representation of signals and systems in	Recitation Section (small)	2	
Prof. Herbert Werner  None  Representation of signals and systems in			2
None Representation of signals and systems in	time and frequency domain, Lapl		
Representation of signals and systems in	time and frequency domain, Lapl		
	time and frequency domain, Lapl		
	amo ana noquonoj domam, zapr	ace transfor	 m
After taking part successfully, students hav	ve reached the following learning	results	
particular explain properties of first and second order systems  They can explain the dynamics of simple control loops and interpret dynamic properties terms of frequency response and root locus  They can explain the Nyquist stability criterion and the stability margins derived from it.  They can explain the role of the phase margin in analysis and synthesis of control loops  They can explain the way a PID controller affects a control loop in terms of its frequence response  They can explain issues arising when controllers designed in continuous time domain a implemented digitally			
vice versa  They can simulate and assess the They can design PID controllers wi They can analyze and synthesiz frequency response techniques They can calculate discrete-time and use it for digital implementation	behavior of systems and control I th the help of heuristic (Ziegler-N ze simple control loops with th approximations of controllers den	oops ichols) tuning the help of esigned in	ng rules root locus ar continuous-tim
	intly solve technical problems, a	and experim	entally valida
· ·	provided sources (lecture notes	s. software	documentatio
experiment guides) and use it when solvin	ng given problems.		
ndependent Study Time 124, Study Time	in Lecture 56		
Written exam			
120 min			
	particular explain properties of first  They can explain the dynamics of terms of frequency response and reference of the phase of the	particular explain properties of first and second order systems  They can explain the dynamics of simple control loops and interesterms of frequency response and root locus  They can explain the Nyquist stability criterion and the stability marg  They can explain the role of the phase margin in analysis and synth  They can explain the way a PID controller affects a control loop response  They can explain issues arising when controllers designed in complemented digitally  Students can transform models of linear dynamic systems from time vice versa  They can simulate and assess the behavior of systems and control of the treatment of the properties of the	<ul> <li>They can explain the dynamics of simple control loops and interpret dynam terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived</li> <li>They can explain the role of the phase margin in analysis and synthesis of control.</li> <li>They can explain the way a PID controller affects a control loop in terms of response.</li> <li>They can explain issues arising when controllers designed in continuous the implemented digitally.</li> <li>Students can transform models of linear dynamic systems from time to frequent vice versa.</li> <li>They can simulate and assess the behavior of systems and control loops.</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tunin.</li> <li>They can analyze and synthesize simple control loops with the help of frequency response techniques.</li> <li>They can calculate discrete-time approximations of controllers designed in and use it for digital implementation.</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for catasks.</li> <li>Students can work in small groups to jointly solve technical problems, and experiment guides) and use it when solving given problems.</li> <li>They can assess their knowledge in weekly on-line tests and thereby control their learn independent Study Time 124, Study Time in Lecture 56.</li> <li>None</li> <li>Written exam</li> </ul>



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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

ourse L0654: Introduction 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 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  Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course	
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>	



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	



Courses					
Title			Тур	Hrs/wk	СР
Practical Exercise Environm	ental Technology (L1387)		Practical Course	1	1
Environmental Technologie	(L0326)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth				
Admission Requirements	None				
Recommended Previous Knowledge	Fundamentals of inorganic/org	anic chemistry and b	piology		
<b>Educational Objectives</b>	After taking part successfully, s	tudents have reache	d the following learni	ng results	
Professional Competence					
Knowledge	With the completion of this technology. They are able to give an overview of scientific d methods.	describe the behavi	our of chemicals in th	ne environmen	t. Students ca
Skills	Students are able to propose problems. They are able to pollutants to migrate and trans Environmental Technology couthese opinons in front of and a	determine geoche form. The students a ntributes to sustainal	mical parameters and are able to work out w	d to assess the well founded of	ne potential pinions on ho
Personal Competence					
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific ar multidisciplinary. They are able to develop different approaches to the task as a group as well as discuss their theoretical or practical implementation.				
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge an tranfer it to new problems.				
Workload in Hours	Independent Study Time 48, S	tudy Time in Lecture	42		
Credit points	3				
Studienleistung	YAS MANA	m nject theoretical ctical work	<b>Description</b> and		
	*** ***				
Examination	Written exam				
Examination Examination duration and scale		ce (German progr	ram): Specialisation	Fneray and	Fnviroment



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

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

Daniera I 0000: Empire ama antal Ta almada nia			
Course L0326: Environn	purse L0326: Environmental Technologie		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta		
Language	DE		
Cycle	WiSe		
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>		
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)		



Courses					
Title			Тур	Hrs/wk	СР
Process and Plant Engineeri	ing I (L0095)		Lecture	2	2
Process and Plant Engineeri	• ,		Recitation Section (large)	1	2
Process and Plant Engineeri			Recitation Section (small)	1	2
Module Responsible	Prof. Georg Fieg				
Admission Requirements	None				
Dagammandad	unit operation of thermal	an dmechanical separation	on processes		
Recommended Previous Knowledge	chemical reactor eingineering				
Educational Objectives	After taking part success	fully, students have reache	ed the following learning	results	
Professional Competence					
	students can:				
	classify and formulate bl	obal balance equations of	chemical processes		
Knowledge	specify linear componen	it equations of complex ch	emical processes		
Knowieuge					
	explain linear regression and data reconcilliation problems explain pfd-diagrams				
	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				
Skills	- solution of data reconcilliation tasks				
	- conduction of process synthesis				
	- economic evaluation of processes and the estimation of production costs				
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time	e 124, Study Time in Lectur	re 56		
Credit points	6				
	<b>Compulsory Bonus</b>	Form	Description		
Studienleistung	Yes 10 %	Subject theoretical practical work	and		
Examination	Written exam	p. mouton			
Examination duration and scale	120 Min. lectures notes a	and books			
	General Engineering Sci General Engineering Sc Compulsory General Engineering Sc Compulsory	ience (German program): ience (German program): cience (German program, ience (German program, 7 Science (German program, program; Elective Compulsory	Specialisation Bioproces 7 semester): Specialisa 7 semester): Specialisation	s Engineeri ation Proces	ng: Compulso ss Engineerin ss Engineerin
Assignment for the	Rionrocese Engineering	: Core qualification: Comp	uleory		



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: Elective Compulsory

Process Engineering: Core qualification: Compulsory

Tvn	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	<ol> <li>Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants     </li> <li>Engineering methods and tools</li> <li>Mass and energy balances</li> <li>Strategies of process synthesis</li> <li>Graphical representation of processes</li> <li>Multidimensional regression</li> <li>Data reconciliation and data validation</li> <li>Process Synthesis</li> <li>Decision levels</li> <li>Experimental process development</li> <li>Reactor synthesis</li> <li>Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams)</li> <li>Process safety</li> <li>Cost estimation of production plants</li> <li>Production costs, capital costs, economic evaluation</li> </ol>
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133

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



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

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	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

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	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0670: Pa	rticle Technology	y and Solids Proce	ss Engineering		
Courses					
Title			Тур	Hrs/wk	СР
Particle Technology I (L0434	4)		Lecture	2	3
Particle Technology I (L0435			Recitation Section (small)	1	1
Particle Technology I (L0440	0)		Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous Knowledge	keine				
Educational Objectives	After taking part succes	ssfully, students have reac	hed the following learning	results	
Professional					
Competence	A0	etion of the module studer	to a second of		
Knowledge	<ul> <li>name and expla</li> </ul>	ain processes and unit-op	perations of solids process as and to discuss their bulk		,
Skills	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		to discuss scientific topics echnical-scientific issues in	orally with other students a group.	or scientific <sub>l</sub>	personal and t
Autonomy	Students are able to ar	nalyze and solve questions	s regarding solid particles	independen	tly.
Workload in Hours	Independent Study Tim	ne 110, Study Time in Lect	ure 70		
Credit points	6				
	Compulsory Bonus	Form	Description		
Studienleistung	Yes None	Written elaboration	sechs Berichte ( 5-10 Seiten	(pro Versuch	ein Bericht)
Examination	Written exam				
Examination duration and scale	90 minutes				
Assignment for the Following Curricula	General Engineering S General Engineering Engineering: Compulse General Engineering S Compulsory General Engineering S Compulsory General Engineering Enviromental Engineering Enviromental Engineering Energy and Environme General Engineering S General Engineering Engineering: Compulse General Engineering S General Engineering S General Engineering S General Engineering S	Science (German program) Gring: Compulsory g: Core qualification: Correctal Engineering: Core qualification: Correctal Engineering: Core qualification: Correctal Engineering: Core qualification: Correctal English program) Science (English program) Science (English program)		s Engineering and ation Proces on Bioproces oecialisation s Engineering and angineering: (	ng: Compulson Enviroment ss Engineering Energy an g: Compulsor Enviroment Compulsory
	Compulsory				



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

Course L0434: Particle	Fechnology 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	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology I		
Тур	Recitation Section (small)	
Hrs/wk	1	
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 1	Fechnology 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	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Module M0829: Fo	undations of Management			
Courses				
Title	0)	Typ	Hrs/wk	CP
Management Tutorial (L0882 Introduction to Management		Recitation Section (large) Lecture	2	3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busines	S		
<del>-</del>	After taking part successfully, students have re-	ached the following learning	results	
Professional Competence				
	After taking this module, students know the im Management, from Planning and Organisatio and Controlling. In particular they are able to  • explain the differences between Eco	n to Marketing and Innovati	on, and also	o to Investmen
Knowledge	<ul> <li>Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry 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 risi  • 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	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coherer report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	Students are able to  work in a team and to organize the tear  to write a report on their project.	n themselves		
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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: Managen	nent Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
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 self-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.



ırse L0880: Introduct	ion to Management
	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: En	vironmental Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment Environmental Assessment		Lecture Recitation Section (small)	2 1	2 1
	· · ·	ricoltation occilon (small)	'	
Admission	Prof. Martin Kaltschmitt			
Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry	and biology		
	After taking part successfully, students have re	eached the following learning	results	
Professional		3 0		
Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competent in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertainties and difficulties with their measurement.			
Skills	The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical of 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.			
	Independent Study Time 48, Study Time in Le	cture 42		
Credit points				
Studienleistung	None Written exam			
Examination Examination duration and scale				
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German procompulsory General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German programmental Engine	ogram): Specialisation Proc program, 7 semester): Sp ram, 7 semester): Specialisation	ess Engine pecialisation ation Proces	ering: Electiv Energy an s Engineering



Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Elective
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Elective Compulsory
	Process Engineering: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0860: Environn	nental 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: Environn	nental Assessment
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better.  Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or
	practical implementation.
Literature	Power point Präsentationen



### **Specialization 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.

Courses				
Title Circuit Theory (L0566) Circuit Theory (L0567)	<b>Typ</b> Lecture Recitation Sec	tion (small)	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and II			
Educational Objectives	After taking part successfully, students have reached the following	ng learning	results	
Professional Competence				
	Students are able to explain the basic methods for calculating electrical circuits. They know the Fouries series analysis of linear networks driven by periodic signals. They know the methods for transier analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.			
2	The students are able to calculate currents and voltages in linear networks by means of bas methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. The are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.			
Personal Competence				
	Students work on exercise tasks in small guided groups. They a their results within the group.	are encoura	ged to pres	ent and discus
	The students are able to find out the required methods for solving the given practice problems Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I.			



Workload in Hours Credit points	Independent Study Time 110, Study Time in Lecture 70
Studienleistung	None
Examination	Written exam
Examination duration and scale	1150 min
_	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): 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 Electrical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): 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

O LOSOC Observit Ti	
Course L0566: Circuit Ti	
	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	WiSe
	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
Content	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
	- 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)
Literature	- 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	
	siehe korrespondierende Lehrveranstaltung	
Literature	see interlocking course	



		ing			
Courses					
<b>Title</b> Computer Engineering (L03: Computer Engineering (L03:			Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
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:  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 of 4,3 up to 4,0 is not possible.				
Educational Objectives	After taking part succes	sfully, students have rea	ached the following learning	results	
Professional Competence					
Knowledge	from the assembly-level  Introduction Combinational combinational n Sequential logic Technological fo Computer arithm Basics of compipelining Memories: Mem	l programming down to logic: Gates, Boolean etworks build: Flip-flops, automata, so build: Integer addition, so puter architecture: Proporty hierarchies, SRAM, from the perspective	functionality of computing signates. The module includes in algebra, Boolean functive yetematic hardware design ubtraction, multiplication and ogramming models, MIPS DRAM, caches of the CPU, principles of patents.	the followin ions, hardv d division single-cyc	g topics:  vare synthesis  le architecture
Skills	structure and the physispecific and individual They are able to disticomputing systems - fro After successful completween a physical counderstand the consequences from the assemble specific and the system.	ical composition of con computers can be built inguish between and om gates and circuits up etion of the module, to omputer system and to uences that the execution	the architect's perspective, inputer systems. The student based on a collection of fet to explain the different at to complete processors.  The students are able to just he software executed on on of software has on the rigates. This way, they will be on an entire system's perspective.	ts can analy ew and simp estraction land dge the interior it. In particular pardware-ce due enabled	yze, how highly le components yers of today! erdependencies ular, they shain tric abstraction to evaluate the
Personal Competence					
Social Competence	Students are able to sol	lve similar problems alo	ne or in a group and to pres	ent the resu	Its accordingly.
Autonomy	Students are able to ac with other classes.	cquire new knowledge	from specific literature and t	to associate	this knowledge
Workload in Hours	Independent Study Time	e 124, Study Time in Le	cture 56		
Credit points					
Studienleistung	Compulsory Bonus Yes 10 %	Form Excercises	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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: 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, 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: Compute	r 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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 M0567: Th	eoretical Electrical Engineering	I: Time-Independent F	ields	
Courses				
Title		Тур	Hrs/wk	СР
	eering I: Time-Independent Fields (L0180)	Lecture	3	5
Theoretical Electrical Engine	eering I: Time-Independent Fields (L0181)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission	None			
Requirements				
Recommended Previous Knowledge	Basic principles of electrical engineering an	d advanced mathematics		
Educational Objectives	After taking part successfully, students have	reached the following learning	n results	
Professional		Todoriod the fellowing rearrang	g 1000110	
Competence				
Knowledge	Students can explain the fundamental formulas, relations, and methods of the theory of time-independent electromagnetic fields. They can explicate the principal behavior of electrostatic magnetostatic, and current density fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-independent electromagnetic fields and are able to explicate these.			
Skills	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time independent, electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell's Equations for more general problems. The students call assess the principal effects of given time-independent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostation magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given field and dimension them for practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subject related tasks in small groups. They are able to prese their results effectively (e.g. during exercise sessions).			
Autonomy	Students are capable to gather necessary information from provided references and relate this information to the lecture. They are 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 their knowledge obtained in this lecture and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis).			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	190-150 minutes			
Assignment for the	General Engineering Science (German prog General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: C	ogram, 7 semester): Specialise ompulsory	ation Electric	cal Engineering



Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0180: Theoretic	cal Electrical Engineering I: Time-Independent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
-	Prof. Christian Schuster
Language	
Cycle	
	<ul> <li>- Maxwell's Equations in integral and differential notation</li> <li>- Boundary conditions</li> <li>- Laws of conservation for energy and charge</li> </ul>
	- Classification of electromagnetic field properties
	<ul> <li>Integral characteristics of time-independent fields (R, L, C)</li> <li>Generic approaches to solving Poisson's Equation</li> </ul>
Content	- Electrostatic fields and specific methods of solving
	<ul> <li>Magnetostatic fields and specific methods of solving</li> <li>Fields of electrical current density and specific methods of solving</li> </ul>
	- Action of force within time-independent fields
	- Numerical methods for solving time-independent problems
	- 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)
Literature	- 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: Theoretic	cal Electrical 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
	Prof. Christian Schuster
Language	
Cycle	SoSe
Content	<ul> <li>- Maxwell's Equations in integral and differential notation</li> <li>- Boundary conditions</li> <li>- Laws of conservation for energy and charge</li> <li>- Classification of electromagnetic field properties</li> <li>- Integral characteristics of time-independent fields (R, L, C)</li> <li>- Generic approaches to solving Poisson's Equation</li> <li>- Electrostatic fields and specific methods of solving</li> <li>- Magnetostatic fields and specific methods of solving</li> <li>- Fields of electrical current density and specific methods of solving</li> <li>- Action of force within time-independent fields</li> <li>- Numerical methods for solving time-independent problems</li> </ul>
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)



ourses				
itle		Тур	Hrs/wk	СР
ignals and Systems (L0432		Lecture	3	4 2
ignals and Systems (L0433		Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	INONE			
	Mathematics 1-3			
	The modul is an introduction to the theoretovered by the moduls Mathematik 1-3 is a (Fourier series, Fourier transform, Laplace to	expected. Further experience w	ith spectral t	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence	1 1			
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.			
Skills	The students are able to describe and ana using methods of signal and system theor important properties such as magnitude and the impact of LTI systems on the signal prop	ry. They can analyse and designd phase response, stability, line	n basic systearity etc Th	ems regardin
Personal Competence				
Social Competence	The students can jointly solve specific probl			
Autonomy	The students are able to acquire relevant control their level of knowledge during the clicker system.			-
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	I UI I MIN			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro	gram): Specialisation Process E gram): Specialisation Bioproces in program): Specialisation in program): Specialisation gram): Specialisation Biomedica ogram, 7 semester): Specialisation	ngineering: s Engineerir Civil- and Mechanical al Engineerir tion Electrica	Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

Assignment for the

**Following Curricula** 

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 Enviromental Engeneering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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 M0748: Ma	iterials in Electrical Engineering			
Wodale Wo7 40. Wa	iterials in Electrical Engineering			
Courses				
Courses				
Title		Тур	Hrs/wk	СР
Electrotechnical Experiments (L0714)		Lecture	1	1
Materials in Electrical Engine		Lecture	2	3
Materials in Electrical Engine	eering (Problem Solving Course) (L0687)	Recitation Section (small)	2	2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool level physics and mathematics			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence				
Knowledge	Students can explain the composition and the structural properties of materials used in electrica engineering. Students can explicate the relevance of mechanical, electrical, thermal, dielectric magnetic and chemical properties of materials in view of their applications in electrical engineering.			
Skills	Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solutions and judge factors influential on the performance of materials in electrical engineering applications.			
Personal Competence  Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.			
Autonomy	Students are capable to extract relevant information from the provided references and to relate thi 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 their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Studienleistung	None			
,	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German program): Specialisation Electrical Engineering: 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, 7 semester): Specialisation Electrical Engineering: Compulsory			

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory



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



Course L0685: Materials	s in Electrical Engineering	
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	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. Angular momentum The hydrogen atom Waves in periodic potentials Reciprocal lattice and reciprocal lattice vectors Band gap Band diagrams The free electron gas and the density of states Fermi-Dirac distribution Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping. The P-N junction (diode) Light emitting diodes Electromagnetic waves interacting with materials Reflection and refraction Photonic band gaps Origins of magnetization Hysteresis in ferromagnetic materials Magnetic domains	
Literature	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	<ul> <li>Atom structure and periodic system</li> <li>Atom binding and crystal structure</li> <li>Structure and properties of alloys:     diffusion, phase diagrams, phase separation and grain boundaries</li> <li>Material properties:     Mechanical, thermal, electrical, dielectric properties</li> <li>Metals</li> <li>Semiconductors</li> <li>Ceramics and glasses</li> <li>Polymers</li> <li>Magnetic materials</li> <li>Electrochemistry     Oxidation numbers, electrolysis, batteries, fuel cells</li> </ul>	
Literature	H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993)	



Module M0709: Ele	ectrical Engineering IV: T	ransmission	Lines and R	esearch Sem	inar
Courses					
Title	I Engineering, Computer Science, Math	nematics (L0571)	<b>Typ</b> Seminar	Hrs/wk	<b>CP</b> 2
Transmission Line Theory ( Transmission Line Theory (			Lecture Recitation Section (	2 large) 2	3 1
Module Responsible	Prof. Arne Jacob				
Admission Requirements	None				
Recommended Previous Knowledge	Electrical Engineering I-III, Mathen	natics I-III			
<b>Educational Objectives</b>	After taking part successfully, stude	ents have reache	ed the following le	arning results	
Professional Competence		and the state of			
Knowledge	Students can explain the fundam frequencies. They are able to and They can describe simple equiva with coupled transmission lines. To	alyze circuits with alent circuits of tr	n transmission line ansmission lines.	es in time and fred They are able to	quency domain solve problems
Skills	Students can analyze and calcul lines. They are able to analyze analyze equivalent circuits of transmission lines using the vectorofessionals.	circuits in frequensmission lines.	ency domain and They are able to s	I with the Smith of solve problems income	chart. They car cluding coupled
Personal Competence  Social Competence	Students can analyze and solve compare the learned theory with able to present a research topic to	experiments in t	he lecture and dis	scuss it in small gr	-
Autonomy	The students can solve problems by their own and are able to acquire skills from the lecture and the literature. They are able to test their knowledge using computer animations. They can test their level of knowledge by answering short questions and tests during the lecture. They are able to relate their acquired knowledge to other lectures (e.g. Electrical Engineering I-III and Mathematics I-III). They can familiarize themselves with a research topic and can prepare a presentation.				
Workload in Hours	Independent Study Time 96, Study	y Time in Lecture	84		
Credit points	6				
Studienleistung	Compulsory Bonus Form Yes None Subject practical	ct theoretical al work	<b>Descripti</b> and	on	
Examination	Written exam				
Examination duration and scale	150 min				
Assignment for the Following Curricula	General Engineering Science (Ge General Engineering Science (Ge Compulsory Electrical Engineering: Core quality General Engineering Science (Eng General Engineering Science (Eng Compulsory	erman program, fication: Compuls glish program): S	7 semester): Spe sory Specialisation Elec	cialisation Electric	al Engineering



Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: 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	
Content	<ul> <li>- Wave propagation along transmission lines</li> <li>- Transient behavior of transmission lines</li> <li>- Transmission lines in steady state</li> <li>- Impedance transformation and Smith chart</li> <li>- Equivalent circuits</li> <li>- Coupled transmission lines and symmetrical components</li> </ul>	
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: Ma	athematics IV			
Courses				
Title		Тур	Hrs/wk	СР
	tial Differential Equations) (L1043)	Lecture	2	1
	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	I Mainematice I - III			
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together common language.</li> <li>In doing so, they can communicate</li> </ul>	new concepts according to the	needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking the can specify open questions precise</li> <li>Students have developed sufficient oriented manner on hard problems.</li> </ul>	ly and know where to get help in persistence to be able to work for	solving the	m.
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points				
Studienleistung				
	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	erential Equations 2)		



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

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

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

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

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

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

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

# Assignment for the Following Curricula

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

Theoretical Mechanical Engineering: Compulsory

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

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

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

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

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory 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	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  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  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1041: Complex Functions	
Тур	Recitation Section (small)
Hrs/wk	1
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: Int	roduction to Communications and	Random Processes	;	
Courses				
	ions and Random Processes (L0442) ions and Random Processes (L0443)	Typ Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Signale and Systems			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.			
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method.			
Personal Competence  Social Competence	The students can idently solve enceific problems	s.		
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.			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	190 min			
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Course L0442: Introduct	ion to Communications and Random Processes
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Fundamentals of random processes</li> <li>Introduction to communications engineering</li> <li>Quadrature amplitude modulation</li> <li>Description of radio frequency transmission in the equivalent complex baseband</li> <li>Transmission channels, channel models</li> <li>Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)</li> <li>Fundamentals of information theory, source coding, channel coding</li> <li>Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist</li> </ul>
	condition, matched filter, detection, error probability  • Fundamentals of digital modulation  K. Kammeyer: Nachrichtenübertragung, Teubner
Literature	R. 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.

ourse 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



Title Theoretical Electrical Engineering II: Time-Dependent Fields (L0182) Theoretical Electrical Engineering II: Time-Dependent Fields (L0183)  Module Responsible  Admission Requirements  Recommended Previous Knowledge  Educational Objectives After taking part successfully, students have reached the following lea Professional Competence  Students are able to explain fundamental formulas, relations, and time-dependent electromagnetic fields. They can assess the principe quasistationary and fully dynamic fields with regard to respective properties of complex electromagnetic fields by means of superposit The students are aware of applications for the theory of time-dependent able to explicate these.  Students are able to apply a variety of procedures in order to se equation for general time-dependent field problems. They can assess time-dependent sources of fields and analyze these quantitatively quantities for the characterization of fully dynamic fields (wave in applications.)  Personal Competence  Students are able to work together on subject related tasks in small their results effectively (e.g. during exercise sessions).  Students are capable to gather necessary information from provinformation to the lecture. They are able to continually reflect their k that accompany the lecture, such as short oral quizzes during the related to the exam. Based on respective feedback, students are evices and on process. They are able to draw connections between as respective feedback, students are evices and on process. They are able to draw connections between as respective feedback, students are evices and on the process. They are able to draw connections between as respective feedback, students are evices and the Hamburg University of Technology (TUHH), e.g. engineering and optics.	,	Hrs/wk 3 2	<b>CP</b> 5
Theoretical Electrical Engineering II: Time-Dependent Fields (L0183)    Module Responsible	,		5
Module Responsible	,	2	
Admission Requirements    Electrical Engineering I, Electrical Engineering II, Theoretical Electrical Engineering II, Mathematics III, Mathematics II, Mathematics III, Mathematics			1
Recommended Previous Knowledge  Educational Objectives  After taking part successfully, students have reached the following lea time-dependent electromagnetic fields. They can assess the principa quasistationary and fully dynamic fields with regard to respective properties of complex electromagnetic fields by means of superposit The students are able to apply a variety of procedures in order to stequation for general time-dependent field problems. They can assest time-dependent sources of fields and analyze these quantitatively quantities for the characterization of fully dynamic fields (wave in section).  Skills  Personal Competence  Students are able to work together on subject related tasks in small interpret applications.  Students are able to gather necessary information from provinformation to the lecture. They are able to continually reflect their k that accompany the lecture, such as short oral quizzes during the related to the exam. Based on respective feedback, students are research at the Hamburg University of Technology (TUHH), e.g.			
Electrical Engineering I, Electrical Engineering II, Theoretical Electrical Engineering III, Theoretical Electrical Engineers III, Autonomy English III, Autonom			
Recommended Previous Knowledge  Educational Objectives  After taking part successfully, students have reached the following lead time-dependent electromagnetic fields. They can assess the principal quasistationary and fully dynamic fields with regard to respective properties of complex electromagnetic fields by means of superposit The students are aware of applications for the theory of time-dependent able to explicate these.  Students are able to apply a variety of procedures in order to so equation for general time-dependent field problems. They can asses time-dependent sources of fields and analyze these quantitatively quantities for the characterization of fully dynamic fields (wave in vector, radiation resistance, etc.) from given fields and interpret applications.  Personal Competence  Students are able to work together on subject related tasks in small their results effectively (e.g. during exercise sessions).  Students are capable to gather necessary information from provinformation to the lecture. They are able to continually reflect their ket that accompany the lecture, such as short oral quizzes during the related to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are expected to the exam. Based on respective feedback, students are ex	. – .		
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research at the Hamburg University of Technology (TUHH), e.g.			
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Workload in Hours Independent Study Time 110, Study Time in Lecture 70			
Credit points 6			
Studienleistung None			
Examination Written exam  Examination duration			
and scale 90-150 minutes			
General Engineering Science (German program): Specialisation Elec		Engineerin	g: Compulsory
General Engineering Science (German program, 7 semester): Spec Compulsory	rical E	Linginiooinii	cal Engineering



Assignment for the | Electrical Engineering: Core qualification: Compulsory

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

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Technomathematics: Core qualification: Elective Compulsory

Course L0182: Theoretic	cal Electrical Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 108, Study Time in Lecture 42
	Prof. Christian Schuster
Language Cycle	
- Oyele	- 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
Content	- 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
	- 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)
Literature	- 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: Theoretic	cal Electrical Engineering II: Time-Dependent Fields
Тур	Recitation Section (small)
Hrs/wk	2
СР	
	Independent Study Time 2, Study Time in Lecture 28
-	Prof. Christian Schuster
Language Cycle	
Oycle	- 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
Content	- 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
	- 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)
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	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M1235: Ele	ectrical Power Systems I			
Courses				
Title Electrical Power Systems I Electrical Power Systems I		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Electrical Engineering			
Educational Objectives	After taking part successfully, students ha	ve reached 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				
	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 emphasis of the lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	190 - 150 minutes			
Assignment for the Following Curricula				



ourse L1670: Electrical Power Systems I			
Тур	Lecture		
Hrs/wk	3		
СР			
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42		
Lecturer	rof. 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         ines             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		
Literature	<ul> <li>K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013</li> <li>A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017</li> <li>R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008</li> </ul>		
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Hrs/wk 2 CP 2 Workload in Hours	endependent Study Time 32, Study Time in Lecture 28  Prof. Christian Becker  DE  WiSe   Indicate the fundamentals and current development trends in electric power engineering  It tasks and history of electric power systems  It symmetric three-phase systems  Indicate three-pha
Workload in Hours Inc Lecturer Pr Language DI Cycle W	endependent Study Time 32, Study Time in Lecture 28  Prof. Christian Becker  DE  WiSe   Indicate the fundamentals and current development trends in electric power engineering  It tasks and history of electric power systems  It symmetric three-phase systems  Indicate three-pha
Workload in Hours Inc Lecturer Pr Language DI Cycle W	Prof. Christian Becker  DE  WiSe  Independent Study Time 32, Study Time in Lecture 28  OE  Vise  Independent Study Time 32, Study Time in Lecture 28  Independent Study Time in Lecture 28  Independen
Lecturer Pr Language DI Cycle W	Prof. Christian Becker  DE  WiSe  Indicate the fundamental 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
Language DI Cycle W	• 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
Cycle W	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         ines         transformers         synchronous machines
	<ul> <li>fundamentals and current development trends in electric power engineering</li> <li>tasks and history of electric power systems</li> <li>symmetric three-phase systems</li> <li>fundamentals and modelling of eletric power systems         <ul> <li>lines</li> <li>transformers</li> <li>synchronous machines</li> </ul> </li> </ul>
Content	<ul> <li>tasks and history of electric power systems</li> <li>symmetric three-phase systems</li> <li>fundamentals and modelling of eletric power systems         <ul> <li>lines</li> <li>transformers</li> <li>synchronous machines</li> </ul> </li> </ul>
	<ul> <li>induction machines</li> <li>loads and compensation</li> <li>grid structures and substations</li> <li>fundamentals of energy conversion</li> <li>electro-mechanical energy conversion</li> <li>thermodynamics</li> <li>power station technology</li> <li>renewable energy conversion systems</li> <li>steady-state network calculation</li> <li>network modelling</li> <li>load flow calculation</li> <li>(n-1)-criterion</li> <li>symmetric failure calculations, short-circuit power</li> <li>control in networks and power stations</li> <li>grid protection</li> <li>grid planning</li> <li>power economy fundamentals</li> </ul>
20	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017



Module M0760: Ele	ectronic Devices				
Courses					
Title Electronic Devices (L0720) Electronic Devices (L0721)			Typ Lecture Project-/problem-based Learning	Hrs/wk 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Hoc Khiem Trieu		Loarring		
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part successfu	ully, students have reache	ed the following learning	results	
Professional Competence					
Knowledge	to explain the ope     to outline device     and	asics of semiconductor phrating principle of importations and equivalent tation of device models.	ant semiconductor device		their derivation
Skills		n basic circuits, sical context and to solve	complex problems by one	eself	
Personal Competence					
Social Competence	Students are able to prep discuss the results in fron		experiments in team wor	rk as well as	to present and
Autonomy	Students are capable to a	cquire knowledge based	on literature in order to p	repare their	experiments.
Workload in Hours	Independent Study Time	110, Study Time in Lectur	re 70		
Credit points	6				
Studienleistung	Yes 10 %	Form  Subject theoretical practical work	Description Studierenden e Wissen zu eir demonstrieren Versuches m Diskussion. Dar Gruppe eine Übr	nem bestim dieses in nit Präse rüber hinau ungsaufgab	nmten Thema, Form eines ntation und s betreut jede e, die inhaltlich
Examination	Written exam				
Examination duration and scale	1 120 min				



	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
_	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
	Compulsory

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



Course L0721: Electroni	Course 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	



Module M0783: Me	asurements: Me	ethods and Data Pro	cessing		
Courses					
Title			Тур	Hrs/wk	СР
EE Experimental Lab (L0781			Practical Course	2	2
Measurements: Methods an Measurements: Methods an	• • • • • • • • • • • • • • • • • • • •	,	Lecture Recitation Section (small)	2 1	3 1
		,	necitation Section (Smail)	'	'
Admission	Prof. Alexander Schla	leter			
Requirements	None				
Recommended Previous Knowledge	principles of mathema principles of electrical				
Educational Objectives	After taking part succe	essfully, students have reach	ned the following learning	results	
Professional					
Competence  Knowledge	measurements. They	le to explain the purpose of can detail aspects of probal udents know methods to digi	oility theory and errors, an	d explain th	e processing of
Skills	The students are able processing of measur	e to evaluate problems of ements.	metrology and to apply n	nethods for	describing and
Personal Competence					
Social Competence	The students solve pro	oblems in small groups.			
Autonomy	The students can reflect their knowledge and discuss and evaluate their results.				
Workload in Hours	Independent Study Ti	me 110, Study Time in Lectu	ire 70		
Credit points	6				
Studienleistung	Compulsory Bonus Yes 10 %	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Elective Compulsory Electrical Engineering General Engineering General Engineering Elective Compulsory Computational Science Computational Science Technomathematics:	Science (German program): Science (German program): g: Core qualification: Compuscience (English program): Science (English program): ce and Engineering: Special ce and Engineering: Special Specialisation III. Engineering Core qualification: Elective (English program):	, 7 semester): Specialisatellsory Specialisation Electrical E, 7 semester): Specialisatellisation Engineering Sciencisation Computer Scienceng Science: Elective Comp	Engineering ion Electric ices: Electiv :: Elective C	al Engineering: : Compulsory al Engineering: e Compulsory



Course L0781: EE Exper	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: Measure	Course L0779: Measurements: 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		
	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: Measure	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 Title		Тур	Hrs/wk	СР
ntroduction to Control Syste ntroduction to Control Syste	, ,	Lecture Recitation Section (small)	2	4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and system	ns in time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, student	s have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	vice versa  They can simulate and assess They can design PID controlle They can analyze and synt frequency response technique They can calculate discrete-and use it for digital implement	time approximations of controllers de	oops ichols) tuning the help of esigned in	ng rules root locus an continuous-tim
Personal Competence				
Social Competence	Students can work in small groups their controller designs	to jointly solve technical problems, a	ind experim	entally validat
Autonomy	Students can obtain information from experiment guides) and use it when s	om provided sources (lecture notes solving given problems. weekly on-line tests and thereby contro		
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Studienleistung				
Examination				
Examination duration and scale	120 min			



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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



Course L0655: Introduct	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	



Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Designation Semiconductor Circuit Designation		Lecture Recitation Section (sm	3 nall) 1	4 2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	INone			
Recommended Previous Knowledge		ering		
Educational Objectives	After taking part successfully, stud	ents have reached the following lear	ning results	
Professional Competence				
Knowledge	<ul> <li>Students know the fundar disadvantages.</li> <li>Students have solid knowl specifications.</li> <li>Students are able to explain</li> </ul>	in the functionality of different MOS dimental digital logic circuits and can ledge about memory circuits and can in how analog circuits functions and viriate fields for the use of bipolar trans	n explain their where they are	advantages and
Skills	parameters of electronic cires.  • Students are able to deversible.	he specifications of different MOS rcuits. elop different logic circuits and can devices, operational amplifiers and	design differe	nt types of logi
Personal Competence				
Social Competence	<ul> <li>Students working togethe</li> </ul>	ciently in heterogeneous teams. er in small groups can solve probl	ems and answ	ver professional
Autonomy	Students are able to asses	s their level of knowledge.		
Workload in Hours	Independent Study Time 124, Stud	dy Time in Lecture 56		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	1120 min			
	General Engineering Science (C Mechatronics: Compulsory General Engineering Science (Ge Compulsory	rman program): Specialisation Electr German program): Specialisation Merman program, 7 semester): Specialisman program, 7 semester): Speciali	dechanical Eng	ineering, Focu



	Focus Mechatronics: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory	
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus	ś
Following Curricula	Marcharlanda Araba Araba Israel	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:	:
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	,
	Focus Mechatronics: Compulsory	
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective	,
	Compulsory	
	Mechanical Engineering: Specialisation Mechatronics: Compulsory	
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Core qualification: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

	ductor 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	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> <li>From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).</li> </ul>
Literature	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011 ISBN: 047170055S  HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik un Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674  K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944  U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496  H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berli 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: Semiconductor Circuit Design		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Matthias Kuhl	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>	
Literature	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S  HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674  K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944  U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496  H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867  URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499  URL: http://dx.doi.org/10.1007/978-3-642-20887-4  URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955  URL: http://www.ciando.com/img/bo	



Module M0829: Fo	undations of Management			
Courses				
Title  Management Tutorial (L088) Introduction to Management		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	I Racic Knowiadda of Wathamatice and Rijcina	SS		
	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	After taking this module, students know the in Management, from Planning and Organisation and Controlling. In particular they are able to explain the differences between Economics.	on to Marketing and Innovati	on, and als	o to Investmen
Knowledge	Management and to name important of explain the most important aspects of aspects of entrepreneurial projects.	lefinitions from the field of Mar and goals in Management ar as functions as production, p ation and human ressource at and marketing d decision making in Busines and explain some basic m	nagement and name the procurement management ss, esp. in sethods from	most important and sourcing ent, information
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry 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 ris • 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	work successfully in a team of student     to apply their knowledge from the lec report on the project     to communicate appropriately and     to cooperate respectfully with their fell	ture to an entrepreneurship p	roject and v	vrite a coheren
Autonomy	Students are able to  work in a team and to organize the tea  to write a report on their project.	um themselves		
	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek	
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 self-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.	



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



Module M0734: ER	ectrical Engineering Project Labor	alory		
Courses				
Title		<b>Typ</b> Project-/problem-based	Hrs/wk	СР
Electrical Engineering Project Laboratory (L0640)  Learning  5 6			6	
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
	Electrical Engineering I, Electrical Engineering	) II		
Recommended Previous Knowledge				
Educational Objectives	I	ached the following learning	results	
Professional Competence		5 5		
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 appropriate technical language. They can			
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems. They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students are 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 a qualified audience. Students have the ability to			
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration and scale	based on task + presentation			
Assignment for the Following Curricula	General Engineering Science (German progra General Engineering Science (German progra Compulsory Electrical Engineering: Core qualification: Cor General Engineering Science (English progra General Engineering Science (English progra	ram, 7 semester): Specialisan npulsory m): Specialisation Electrical	tion Electric	al Engineering



Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Core qualification: Elective Compulsory

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



### **Specialization 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  $CO_2$  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  $CO_2$  emissions is pursued by increasing efficiency and also through separation and underground storage of the  $CO_2$  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<sub>2</sub> 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<sub>2</sub> 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	Ту	/p	Hrs/wk	СР
Computer Engineering (L032	21) Le	ecture	3	4
Computer Engineering (L032	24) Re	ecitation Section (small)	1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in electrical engineering  The successful completion of the labs will be he examination according to the following rules:  1. Upon a passed module examination, the strength marks due to the successful labs, such that respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and	tudent is granted a both the examination's ma	onus on the	e examinatio
<b>Educational Objectives</b>	After taking part successfully, students have reached	the following learning	results	
Professional Competence	This module deals with the foundations of the function from the assembly-level programming down to gates.  • Introduction • Combinational logic: Gates, Boolean alge-	The module includes	the following	g topics:



#### Knowledge

combinational networks

- Sequential logic: Flip-flops, automata, systematic hardware design
- Technological foundations
- Computer arithmetic: Integer addition, subtraction, multiplication and division
- Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining
- Memories: Memory hierarchies, SRAM, DRAM, caches
- Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses

The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the 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.

Skills After successful completion of the module, the students are able to judge the interdependencies between a physical computer 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

Studienleistung	Compulsory	Bonus	Form	Description
	Yes	10 %	Excercises	

#### **Examination** 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): Core qualification: 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 Assignment for the General Engineering Science (English program, 7 semester): Specialisation Computer Science: **Following Curricula** 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: 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: Compute	r Engineering	
Тур	Lecture	
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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	



Course L0324: Computer 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 M0933: Fu	ndamentals of Materials Science			
Courses				
Title	Typ Science I (L1085) Lect		Hrs/wk	CP
Fundamentals of Materials S Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and Lect		2	2
. , , ,	cs of Materials Science (L1095) Lect	ure	2	2
	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached th	e following learning r	esults	
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge describe this knowledge comprehensively. Fundam issues of atomic structure, microstructure, phase diamechanical properties. The students know about the materials and can identify relevant approaches for chatrace materials phenomena back to the underlying physical structure.	ental knowledge her agrams, phase transf e key aspects of cha racterizing specific pr	e means spormations, curacterization roperties. The	ecifically the corrosion and methods for
Skills	The students are able to trace materials phenomena laws of nature. Materials phenomena here refers to mand stiffness, chemical properties such as corrosion resolidification, precipitation, or melting. The students conditions and the materials microstructure, and they the material's behavior.	echanical properties sistance, and to phas can explain the rela	such as strei se transforma ation betwee	ngth, ductility tions such as n processing
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	180 min			
		: Specialisation Er	nergy and	Enviromental
	Engineering: Compulsory General Engineering Science (German program	n): Specialisation M	Mechanical	Engineering
	Compulsory General Engineering Science (German program): Spec General Engineering Science (German program): Spec General Engineering Science (German program, 7 sem	cialisation Biomedical cialisation Naval Arch	Engineering	: Compulsory
	Compulsory General Engineering Science (German program, 7 sen Compulsory General Engineering Science (German program, 7			
	Compulsory General Engineering Science (German program, 7)			
	·			



	Environmental Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Energy and Environmental
Following Curricula	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 Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective 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 of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider	
Language	DE	
Cycle	SoSe	
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7	



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



Module M0598: Me	echanical Enginee	ering: Design			
Courses					
Title			Тур	Hrs/wk	СР
Embodiment Design and 3D	-CAD (L0268)		Lecture	2	1
Mechanical Design Project I	(L0695)		Project-/problem-based Learning	3	2
Mechanical Design Project I	I (L0592)		Project-/problem-based Learning	3	2
Team Project Design Metho	dology (L0267)		Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge	<ul> <li>Mechanics</li> </ul>	f Mechanical Engineering f Materials Science neering	Design		
Educational Objectives	After taking part success	sfully, students have reach	ed the following learning	results	
Professional					
Competence	Afternational	and dealers and the			
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,</li> <li>describe basics of 3D CAD,</li> <li>explain basics methods of engineering designing.</li> </ul>				
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	! !	a etudante ara abla to:			
Social Competence	<ul> <li>After passing the module, students are able to:</li> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> <li>moderate the use of scientific methods,</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course.</li> </ul>				
Autonomy	Students are able  to estimate the	ir level of knowledge usin	ng activating methods w	vithin the led	ctures (e.g. with
Autonomy	clickers),  • To solve engine	ering design tasks systema	atically.		
Workload in Hours	II Independent Study Time	e 40, Study Time in Lecture	<u> </u>		
Credit points		-, -: j ::::: 200taic	<del>-</del>		
Studienleistung	Compulsory Bonus Yes None	Form Written elaboration Written elaboration Written elaboration Written elaboration	Description		
Examination	Written exam				
Examination duration					
_	ı				



and scale	180
	General Engineering Science (German program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory  Constal Engineering Science (Cormon program 7 competer): Specialization Energy and
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Energy and Environmental
Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	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

ourse L0268: Embodim	nent 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	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system         <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K. Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H. Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0695: Mechanical Design Project I		
Тур	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	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts</li> <li>(bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>	
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>	

Course L0592: Mechanical Design Project II			
Тур	Typ 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	<ul> <li>Generation of sketches for functions and sub-functions</li> <li>Approximately calculation of shafts</li> <li>Dimension of bearings, screw connections and weld</li> <li>Generation of engineering drawings (assembly drawings, manufacturing drawing)</li> </ul>		
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.		



ourse 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	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Courses							
Title			Тур		Hrs/wk	СР	
Fundamentals of Fluid Mechanics (L0091) Fluid Mechanics for Process Engineering (L0092)				Lecture Recitation Se	ction (large)	2 2	4 2
Module Responsible	Prof. Michael Schli	iter					
Admission Requirements	None						
Recommended Previous Knowledge							
<b>Educational Objectives</b>	After taking part su	ccessfully,	students have	reached the follow	ing learning	results	
Professional Competence							
Knowledge	<ul> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in process engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physic boundary conditions</li> </ul>						
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>						
Personal Competence							
Social Competence	information  able to work results effective	to the contour to the	ext of the lect on subject re nglish (e.g. du	om subject related, ure and lated tasks in smal ring small group ex ercises by themselv	l groups. Th ercises)	ey are able	to present the
Autonomy		er literature		ic and to expand the and to evaluate the	_		
Workload in Hours	Independent Study	Time 124,	Study Time in	Lecture 56			
Credit points	6						
Studienleistung	Compulsory Bonus Form Description Yes 5 % Midterm						
Examination	Written exam						
Examination duration and scale	2 hours						



General Engineering Science (German program): Specialisation Energy and Environmental **Engineering: Compulsory** General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and **Environmental Engineering: Compulsory** Bioprocess Engineering: Core qualification: Compulsory Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (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 Process Engineering: Core qualification: Compulsory

Course I 0091 · Fundame	entals of Fluid Mechanics
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Michael Schlüter
Language	
Cycle	
Content	<ul> <li>fluid properties</li> <li>hydrostatic</li> <li>overall balances - theory of streamline</li> <li>overall balances- conservation equations</li> <li>differential balances - Navier Stokes equations</li> <li>irrotational flows - Potenzialströmungen</li> <li>flow around bodies - theory of physical similarity</li> <li>turbulent flows</li> <li>compressible flows</li> </ul>
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994.</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006.</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008.</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009.</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007.</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008.</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006.</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011.</li> </ol>



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



Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Thanh Trung Do			
Admission Requirements	None			
	Basics of mathematics, in particular complexe	numbers, integrals, differenti	als	
Recommended Previous Knowledge	Basics of electrical engineering and mechanic	cal engineering		
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional		-		
Competence				
	Students can to draw and explain the basic p	rinciples of electric and magn	etic fields.	
Knowledge	They can describe the function of the s corresponding equations and characteristic major parameters of the energy efficiency engine.	curves. For typically used d	rives they	can explain the
	Students arw able to calculate two-dimension circuits with air gap. For this they apply the us	=	•	_
Skills	They can calulate the operational performance and selected quantities and characteristic graphical methods.			
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate able to analyse independently the operationa data and theycan calculate thereof selected q	I performance of electric mach	nines from th	•
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Aggignment for the	General Engineering Science (German Engineering: Compulsory General Engineering Science (German progremental Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German progremental Engineering Science (German progremental Engineering: Core qualification: Electrical Engineering: Core qualification: Core	gram): Specialisation Mechan program, 7 semester): Specialisation am, 7 semester): Specialisation ctive Compulsory equalification: Compulsory	nical Engin pecialisation on Mechanic	eering: Electivon Energy and cal Engineering
Assignment for the Following Curricula	General Engineering Science (English Engineering: Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English progra	gram): Specialisation Mechan	nical Engin	eering: Electiv



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

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Elective Compulsory

Mechatronics: Core qualification: Compulsory

ourse L0293: Electrical	I Machines
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thanh Trung Do
Language	DE
Cycle	SoSe
	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 layou (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,
	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur de 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. Thanh Trung Do, Weitere Mitarbeiter			
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"			



Courses				
Title		Typ	Hrs/wk	СР
Power Industry (L0316)		<b>Typ</b> Lecture	nrs/wk 1	1
Energy Systems and Energy	/ Industry (L0315)	Lecture	2	2
Renewable Energy (L0313)	, made ay (20010)	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission				
Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional				
Competence				
Knowledge	systems and their economic efficiency. The Furthermore, they can explain details of power egard to subject-related contexts. The student many energy systems in general, especially for Furthermore, the students can explain the envir	r generation, power distributs can explain these aspectives rrenewable energy system	tion and po ets, which a s and critica	wer trading w re applicable al discuss ther
Skills	Students are able to apply methodologies for production for various types of energy syste technically, environmentally and economicall Therefore, they can choose the necessary subsolutions of a problem.  The students are able to explain questions and renewable energies orally and to put them then	ms. Furthermore, they can ly and design them under ject-specific calculation rule I possible approaches to its	evaluate of certain gings, also for n	energy systen ven condition ot standardize
Personal Competence				
Social Competence	The students are able to analyze suitable tec economical and ecological criteria under susta contribuition to a more sustainable power supp	inability aspects. This allow		
Autonomy	Students can independently exploit sources, acquire the particular knowledge about the subject are and transform it to new questions.			
Workload in Hours	Independent Study Time 96, Study Time in Lect	ture 84		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following Curricula	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German p Environmental Engineering: Compulsory General Engineering Science (German program Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core of General Engineering Science (English put Engineering: Compulsory	rogram, 7 semester): Specialisation	oecialisation	n Energy ar cal Engineerin



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

Course L0316: Power Inc	dustry
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
Content	<ul> <li>Electrical energy in the energy system</li> <li>Demand and use of electrical energy (households, industry, "new" buyers (including emobility))</li> <li>Electricity generation <ul> <li>electricity generation technologies using fossil fuels and their characteristics</li> <li>combined heat and power technologies and their production characteristics</li> <li>electricity generation from renewable energy technologies and their characteristics</li> </ul> </li> <li>Power distribution <ul> <li>"classic" distribution of electrical energy</li> <li>challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading)</li> </ul> </li> <li>District heating industry</li> <li>Legal and administrative aspects</li> <li>Energy Act</li> <li>support instruments for renewable energy</li> <li>CHP Act</li> </ul> <li>Cost and efficiency calculation</li>
Literature	Folien der Vorlesung

Course L0315: Energy S	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	<ul> <li>Energy: development and significance</li> <li>Fundamentals and basic concepts</li> <li>Energy demand and future trends (heat, electricity, fuels)</li> <li>Energy reserve and sources</li> <li>Cost and efficiency calculation</li> <li>Final and effective energy from petroleum, natural gas, coal, uranium and other</li> <li>Legal, administrative and organizational aspects of energy systems</li> <li>Energy systems as a permanent optimization task</li> </ul>
Literature	Kopien der Folien



Course L0313: Renewak	ole 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	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewak	ole 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	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Module M0538: He	eat and Mass Transfer			
Courses				
<b>Title</b> Heat and Mass Transfer (L0 Heat and Mass Transfer (L0 Heat and Mass Transfer (L	0102)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	<b>CP</b> 2 2 2
· · · · · · · · · · · · · · · · · · ·	<u>.                                      </u>	Recitation Section (large)	<u> </u>	2
Module Responsible  Admission  Requirements	None			
Recommended Previous Knowledge		nics		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of explair procedural apparatus (e. g. heat exit of the procedural apparatus</li></ul>	changer, chemical reactors).  Id characterize different kinds of fer and thermal radiation.  It is a physical basis for mand quantitative by using suitable	f heat trans ass transfer mass trans	fer mechanisms in detail and to sfer theories.
Skills	<ul> <li>The students are able to set reason using the gained knowledge and respectively.</li> <li>They are capable to solve specifit temperature alteration in fluids) and</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish between They can use this knowledge for column, rectification column).</li> <li>In this context, the students are capable to context, apparatus.</li> <li>In addition, they can calculate both, apparatus.</li> <li>The students are capable to connext of other courses (In particular the process engineering) to solve concentrations.</li> </ul>	to balance the corresponding to heat transfer problems (e.g. to calculate the corresponding estudents can execute scaling the endiffusion, convective mass to the description and design of the course to considering their advantage of the endiffusion considering their advantage of the endiffusion considering their advantage of their knowledge obtained in the courses thermodynamics, fluid	heated checked the heat flows. Up of technic ransition and apparatus damental tyntages and ate processe this course	emical reactors cal processes of d mass transfer (e.g. extraction pes of heat and disadvantages es in procedura with knowlegde
Personal Competence  Social Competence	The students are capable to work rought orally in a receptable manner.		n teams an	d to present the
	<ul> <li>The students are able to find and even their level to procedure continuously (clicker-system)</li> </ul>	rel of knowledge during the o	course with	accompanying



Autonomy	control their learning processes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Studienleistung				
	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective 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  2. 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	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>

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	Typ 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			



Courses					
Title Thermal Separation Processes (L0118) Thermal Separation Processes (L0119) Thermal Separation Processes (L0141)		Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 2 2 1	
Separation Processes (L115	,	Practical Course	1	1	
Module Responsible  Admission	Prof. Irina Smirnova				
Requirements	None				
Recommended Previous Knowledge	Recommended requirements: Thermodyn	amics III			
<b>Educational Objectives</b>	After taking part successfully, students have	re reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>The students can distinguish and distillation, extraction, and adsorpti</li> <li>The students develop an underst process, the estimation of the ene and the selection of separation sys</li> <li>They have good knowledge of des</li> </ul>	on anding for the course of concen rgy demand of a process, the po tems	tration durir	ng a separatic energy savin	
Skills	Using the gained knowledge the sist separation process and can close The students can use different grand define the amount of theoretic. They can select and design a basion the advantages and disadvanta the students are capable to obtain appropriate sources (diagrams and They can calculate continuous and The students are able to prove the The students are able to discuexperimental work with the teacher.  The students are capable of linking their git together for the solution of technical mechanics and chemical engineering.	the associated energy and materiaphical methods for the designinal stages required c type of thermal separation process of the	al balances ng of a sep eess for a gi d material perimental I and the	aration process ven case base properties fro ab work. content of the	
Personal Competence	The students can work technical results in the tutorial	assignments in small groups a	and presen	t the combine	
Social Competence					
Autonomy	<ul> <li>The students are capable to o themselves and assess their qualit</li> <li>The students can proof the state o this way control their learning proc</li> </ul>	y f their knowledge with exam rese			



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Studienleistung	one			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory			



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



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



ırse L0141: Thermal	Separation Processes				
Тур	Recitation Section (large)				
Hrs/wk	1				
СР	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Irina Smirnova				
Language	DE				
Cycle	WiSe				
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>				
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 37985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>				



Course L1159: Separation	on Processes				
Тур	Practical Course				
Hrs/wk	1				
СР	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Irina Smirnova				
Language	DE/EN				
Cycle	SoSe				
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.  The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.  Topics of the practical course:  Introduction in the thermal process engineering and to the main features of separation processes  Simple equilibrium processes, several steps processes  Distillation of binary mixtures, enthalpy-concentration diagrams  Extractive and azeotrope distillation, water vapor distillation, stepwise distillation  Extraction: separation ternary systems, ternary diagram  Multiphase separation including complex mixtures  Designing of separation devices without discrete stages  Drying  Chromatographic separation processes  Membrane separation  Energy demand of separation processes  Advance overview of separation processes  Selection of separation processes				
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>				



Module M0639: Ga	s and Steam Powe	er Plants			
Courses					
Title			Тур	Hrs/wk	СР
Gas and Steam Power Plant Gas and Steam Power Plant	` ,		Lecture Recitation Section (lar	3 ge) 2	4 2
Module Responsible	Prof. Alfons Kather				
Admission Requirements	None				
Recommended Previous Knowledge	<ul><li>"Technical Therm</li><li>"Heat Transfer"</li><li>"Fluid Mechanics</li></ul>	-	d II"		
Educational Objectives	After taking part success	fully, students ha	ave reached the following lear	ning results	
Professional Competence					
<i>K</i> 1 1	The students can evaluate the development of the electricity demand and the energy conversion routes in the thermal power plant, describe the various types of power plant and the layout of the steam generator block. They are also able to determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.  The students have basic knowledge about the principles, operation and design of turbomachinery				
	The students will be able, using theories and methods of the energy technology from fossil fuels and based on well-founded knowledge on the function and construction of gas and steam power plants, to identify basic associations in the production of heat and electricity, so as to develop conceptual solutions. Through analysis of the problem and exposure to the inherent interplay between heat and power generation the students are endowed with the capability and methodology to develop realistic optimal concepts for the generation of electricity and the production of heat. From the technical basic the students become the ability to follow better the deliberations on the electricity mix compositions within the energy-political triangle (economy, secure supply and environmental protection).  Within the framework of the exercise the students learn the use of the specialised software suit EBSILON Professional TM. With this tool small practical tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.				
	The students are able to do simplified calculations on turbomachinery either as part of a plan single component or at stage level.				
Personal Competence					
Social Competence	An excursion within the framework of the lecture is planned for students that are interested. The				
	The students assisted by the tutors will be able to develop alone simple simulation models and run with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary conditions highlighted. The students are able independently to analyse the operational performance of steam power plants and calculate selected quantities and characteristic curves.				
Workload in Hours	Independent Study Time	110, Study Time	e in Lecture 70		
Credit points	6				
	Compulsory Bonus	Form	<b>Description</b> 15-minütige		es Testat übe



Studienleistung	No 5%		station	EBSILON Professional; nur bestanden/nicht bestanden (keine	
	No	5 % Exc	ercises	anteili <b>៉្វាទេ</b> ហក្សឹម <b>ង់</b> ហើងben im Laufe der Vorlesungen à 5 Minuten; bis zu 5 % Bonus je nach Anteil richtiger Abgaben	
Examination	Written exam				
Examination duration and scale	Written exami	nation of 120 min			
_	Engineering: General Engineeral Engineering: General Engineering:	Compulsory ineering Science ms: Compulsory gineering Science Engineering: Con neering Science Systems: Electiv Invironmental Engineering Science Compulsory ineering Science ms: Compulsory neering Science Compulsory neering Science Systems: Electiv Systems: Electiv	ce (German program): Spece (German program, mpulsory German program, 7 seme e Compulsory gineering: Core qualification (English program): e (English program): Spece (English program, 7 seme (English program, 7 seme (English program, 7 seme	Specialisation Energy and Enviromental ecialisation Mechanical Engineering, Focus ster): Specialisation Energy and Enviromental ster): Specialisation Mechanical Engineering,	



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



Tren	Recitation Section (large)			
	· · · · · · · · · · · · · · · · · · ·			
Hrs/wk	-			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Alfons Kather			
Language	DE			
Cycle	WiSe			
	In the 1 <sup>st</sup> part of the lecture a general introduction into fluid-flow machines and steam power plant 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 • Diesel engine systems • Waste heat utilisation  followed by the more specialised issues: • Electricity Demand and Forecasting			
Content	<ul> <li>Thermodynamic fundamentals</li> <li>Energy Conversion in Thermal Power Plants</li> <li>Types of Power Plant</li> <li>Layout of the power plant block</li> <li>Individual elements of the power plant</li> <li>Cooling systems</li> <li>Flue gas cleaning</li> <li>Operation characteristics of the power plant</li> <li>Construction materials</li> <li>Location of power plants</li> <li>The environmental impact of acidification, fine particulate or CO<sub>2</sub> emissions and the resulting clim effects are a special focus of the lecture and the lecture hall exercise. The challenges in p operation from interconnecting conventional power plants and renewable energy sources discussed and the technical options for providing security of supply and network stability presented, also under consideration of cost effectiveness. In this critical review, focus is especiplaced on the compatibility of the different solutions with the environment and climate. With this, awareness for the responsibility of an engineer's own actions are emphasized and the potential exof the different solutions presented clearly.</li> <li>Within the framework of the exercise the students learn the use of the specialised software is EBSILON Professional<sup>TM</sup>. With this tool small tasks are solved on the PC, to highlight aspects of design and development of power plant cycles. The students present their results orally and afterwards ask questions and get feedback. The course work has a positive effect on the students figrade.</li> </ul>			
Literature	<ul> <li>Skripte</li> <li>Kalide: Kraft- und Arbeitsmaschinen</li> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwe Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul>			



Courses							
Title Practical Course: Measurement and Control Systems (L1119) Measurement Technology for Mechanical and Process Engineers (L1116) Measurement Technology for Mechanical and Process Engineers (L1118)		Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1			
Module Responsible	1	3 ( -,	( - 3 - )				
Admission Requirements	!						
<del>-</del>	Basic knowledge of physics, chemistry and electrical engineering						
	After taking part succes	After taking part successfully, students have reached the following learning results					
Professional Competence							
			portant fundmentals of the tion, Static and Dynamic				
Knowledge	They can outline the most important measuring methods for different kinds of quantities to maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).						
	They can describe in Chromatography)	mportant methods of	chemical Analysis (Gas So	ensors, Spe	ctroscopy, G		
Skills	Students can select suitable measuring methods to given problems and can use referir measurement devices in practice.  The students are able to orally explain issues in the subject area of measurement technology ar solution approaches as well as place the issues into the right context and application area.						
Personal Competence	Students can arrive at v	work results in groups	and document them in a com	mon report.			
Social Competence		miliarize themselves w	rith new measurement techno	logies.			
Autonomy							
Credit points	Independent Study Tim	ie 110, Study Time in I	Lecture 70				
C. Call points	Compulsory Bonus	Form	Description				
Studienleistung		Subject theore practical work	·				
Examination	Written exam						
Examination duration and scale	105 minutes						
	Engineering: Compulso General Engineering Compulsory General Engineering S General Engineering S	ory Science (German Science (German progr Science (German progr Science (German	program): Specialisation  program): Specialisation  ram): Specialisation Biomedic  ram): Specialisation Process E  program, 7 semester): S	Mechanica al Engineeri Engineering:	I Engineerir ng: Compulso Compulsory n Energy a		



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

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



ַ יאַרוי	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
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmi Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 E 2455 Bl.1</li> <li>Versuch 2:</li> </ul>
Literature	<ul> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> </ul> Versuch 3:
	<ul> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Ver Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989</li> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> </ul>



Tvn	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
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
Contont	2.6 Data Transmission
Content	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 from the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940.



Course L1118: Measure	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	Dr. Sven Krause		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses					
Title		Ту	/p	Hrs/wk	СР
Practical Exercise Environm	nental Technology (L1387)	=	actical Course	1	1
Environmental Technologie (	(L0326)	Le	cture	2	2
Module Responsible	Dr. Joachim Gerth				
Admission Requirements	INOne				
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry and biology				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	With the completion of this modul the students obtain profound knowledge of environment technology. They are able to describe the behaviour of chemicals in the environment. Students cargive an overview of scientific disciplines involved. They can explain terms and allocate them to relate methods.				
Skills	Students are able to propose appropriate appropriate and transform. Environmental Technology contributhese opinons in front of and agains	ermine geochemic The students are tes to sustainable	ical parameters and able to work out w	d to assess the well founded or	ne potential pinions on ho
Personal Competence					
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop different approaches to the task as a group as well as discuss their theoretical or practical implementation.				
Autonomy	Students can independently exploit tranfer it to new problems.	Students can independently exploit sources about of the subject, acquire the particular knowledge ar tranfer it to new problems.			
Workload in Hours	Independent Study Time 48, Study	Time in Lecture 42	2		
Credit points	3				
	I Yes None	theoretical	<b>Description</b> and		
Studienleistung	practical	work			
	Written exam	work			
	Written exam				



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

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

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



Courses						
litle				Тур	Hrs/wk	СР
ntroduction to Control Syste ntroduction to Control Syste	, ,			Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert	Werner				
Admission Requirements	None					
Recommended Previous Knowledge	-	on of signals and	systems in time an	d frequency domain, Lap	lace transfor	m
Educational Objectives	After taking p	art successfully, s	tudents have reach	ned the following learning	g results	
Professional Competence						
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>					
Skills	vice v They They They frequi	rersa can simulate and can design PID co can analyze and ency response tec can calculate dis use it for digital imp	assess the behavion trollers with the had synthesize simphiques approximate to the control of th	dynamic systems from tin or of systems and control telp of heuristic (Ziegler-Note control loops with t imations of controllers of that Control Toolbox, Sin	loops Nichols) tuning he help of lesigned in	ng rules root locus ar continuous-tim
Personal Competence						
Social Competence		_	roups to jointly so	lve technical problems,	and experim	nentally valida
Autonomy	their controller designs  Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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 9	Study Time in Lecti	 ure 56		
Credit points			2000	· - <del></del>		
Studienleistung						
Examination		1				
Examination duration and scale	,					



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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 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
Literature	<ul> <li>Computer-based exercises throughout the course</li> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	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		



Courses					
Title			Тур	Hrs/wk	СР
Particle Technology I (L043	4)		Lecture	2	3
Particle Technology I (L043	5)		Recitation Section (small)	1	1
Particle Technology I (L044	0)		Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous Knowledge	keine				
	After taking part success	sfully, students have reac	hed the following learning	results	
Professional					
Competence					
	After successful comple	tion of the module studen	ts are able to		
Knowledge			erations of solids process s and to discuss their bulk		,
ranowieage	• characterize par	licies, particie distribution	s and to discuss their bulk	properties	
	Ctudonto ovo oblo to				
	Students are able to				
	<ul> <li>choose and des</li> </ul>	ign apparatuses and pro	cesses for solids processir	ng according	to the desir
Skills					
	asses solids with respect to their behavior in solids processing steps				
			in solids processing steps	5	
	<ul> <li>document their v</li> </ul>		in solids processing steps	5	
Personal Competence	1		in solids processing steps	5	
Personal Competence	The students are able to	vork scientifically.			personal and
Personal Competence	The students are able to	work scientifically.  o discuss scientific topics	orally with other students o		personal and
Social Competence	The students are able to develop solutions for ted	vork scientifically.  o discuss scientific topics chnical-scientific issues in	orally with other students on a group.	or scientific p	
Social Competence	The students are able to develop solutions for ted Students are able to and	o discuss scientific topics chnical-scientific issues in alyze and solve questions	orally with other students on a group. Is regarding solid particles i	or scientific p	
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Social Competence	The students are able to develop solutions for ted Students are able to and Independent Study Time	o discuss scientific topics chnical-scientific issues in alyze and solve questions	orally with other students on a group. Is regarding solid particles i	or scientific p	
Social Competence Autonomy Workload in Hours Credit points	The students are able to develop solutions for ted Students are able to and Independent Study Time 6  Compulsory Bonus	o discuss scientific topics chnical-scientific issues in alyze and solve questions	orally with other students on a group. Is regarding solid particles in the properties of the propertie	or scientific p	tly.
Social Competence Autonomy Workload in Hours	The students are able to develop solutions for ted Students are able to and Independent Study Time 6  Compulsory Bonus	o discuss scientific topics chnical-scientific issues in alyze and solve questions e 110, Study Time in Lect	orally with other students of a group. s regarding solid particles in the properties of the properties	or scientific p	tly.
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Social Competence Autonomy Workload in Hours Credit points Studienleistung Examination	The students are able to develop solutions for ted Students are able to and Independent Study Time 6  Compulsory Bonus Yes None  Written exam	o discuss scientific topics chnical-scientific issues in alyze and solve questions to 110, Study Time in Lect	orally with other students of a group. s regarding solid particles in the properties of the properties	or scientific p	tly.
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Social Competence Autonomy Workload in Hours Credit points Studienleistung Examination	The students are able to develop solutions for ted Students are able to and Independent Study Time 6  Compulsory Bonus Yes None  Written exam 90 minutes	o discuss scientific topics chnical-scientific issues in alyze and solve questions at 110, Study Time in Lect	orally with other students of a group. s regarding solid particles in a group. Use 70  Description sechs Berichte (5-10 Seiten	or scientific p	tly. n ein Bericht)
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Social Competence  Autonomy  Workload in Hours  Credit points  Studienleistung  Examination  Examination duration and scale	The students are able to develop solutions for ted Students are able to ana Independent Study Time 6  Compulsory Bonus Yes None  Written exam  90 minutes  General Engineering Songeral Engineering Environmental Engineering Energy and Environmer General Engineering Songeral Engineeri	cork scientifically.  It discuss scientific topics chnical-scientific issues in alyze and solve questions to 110, Study Time in Lect  Form  Written elaboration  Science (German program) Science (German program) Science (German program) cience (German program) cience (German program) cience (German program) Science (German program) cience (English program) science (English program) science (English program)	orally with other students of a group. Is regarding solid particles if the process of the proces	pro Versuch  ngineering: s Engineerin inergy and ation Proces pecialisation	Compulsory ng: Compulso Enviromen as Engineerir Energy a
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General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Process Engineering: Core qualification: Compulsory

Course L0434: Particle 1	Technology 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	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Course L0435: Particle Technology I		
Тур	Recitation Section (small)	
Hrs/wk	1	
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	Technology 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	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Courses				
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 Knowledge	Fundamentals of inorganic/organic chemis	stry and biology		
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the stuchains of potential environmental problem construction measures. They have knowled in dealing with different methods and in students are able to estimate the complexification and difficulties with their measurement.	ns which might occur from producted about the methodological construments to assess environments	ction proces diversity and ental impac	ses, projects of are compete ts. Besides the
Skills	The students are able to select a suitanssessment methods. Thereby they can environmental problems in a business Assessments independently and can applications. After finishing the course the results or other publications on environments.	develop suitable solutions for context. They are able to ca oply the software programs Op students have the competence	managing rry out Life enLCA and	and mitigating Cycle Impa
Personal Competence				
Social Competence	The students are able to discuss the vari multidisciplinary. They are able to develop practical implementation. Due to the selemulti-layered issues of the environment pand consciousness towards these subject their future social responsibilities in their re-	o jointly different solutions and to ected lecture topics, the studen rotection and the concept of sucts are raised and which helps	discuss the ts receive in stainability.	ir theoretical on Sights into the Their sensitivi
	The students learn to research, process a carry out independent scientific work. The and are able to judge results of other publi	y can solve an environmental pro	-	-
Workload in Hours	Independent Study Time 48, Study Time in	Lecture 42		
Credit points	3			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German prelective Compulsory General Engineering Science (German prelective Compulsory	program): Specialisation Prod n program, 7 semester): Specialisa	ess Engine pecialisation ation Proces	eering: Electiv Energy anss Engineering



Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Elective
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Elective Compulsory
	Process Engineering: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0860: Environn	nental 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	
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: Inf	ormatics for Process Engineers			
Courses				
Title Informatics for Process Eng Informatics for Process Eng Numeric and Matlab (L0125)	ineers (L0837)	Typ Lecture Recitation Section (small) Practical Course	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge in using MS Windows.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence  Knowledge	Students can describe procedural and object-orie	ented concepts.		
Skills	Students are capable of object-oriented programs mathematic questions by using Matlab.  Students are capable of developing concepts (sin			
Personal Competence  Social Competence	Students are able to work out solutions together in	n small groups.		
Autonomy	Students are able to assess acquired skills by app	olying it in practice.		
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points				
Studienleistung				i
Examination  Examination duration	Written exam			
and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German progration Compulsory General Engineering Science (German program Engineering Science (German program Elective Compulsory General Engineering Science (German program Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, Engineering: Elective Compulsory General Engineering Science (English program, Engineering: Elective Compulsory General Engineering Science (English program Elective Compulsory Process Engineering: Core qualification: Compulsory	gram, 7 semester): Specialisation: Compulsory am): Specialisation Procont Semester): Specialisation, 7	pecialisation ation Proces ess Engine n Energy ar	n Energy and ss Engineering: eering: Elective and Enviromental



Course L0836: Informatics for 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 2D graphics Events and Controls		
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addisor 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.		



ourse L0837: Informatics for Process Engineers			
Тур	Typ 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			
Typ	ractical Course		
Hrs/wk			
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	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>		
Literature	Literatur (Software-Teil):  1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004  2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007  3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de  4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005		



Courses					
Title Process and Plant Engineeri Process and Plant Engineeri Process and Plant Engineeri	ing I (L0096)		Typ Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible					
Admission Requirements					
Recommended	-	unit operation of thermal an dmechanical separation processes chemical reactor eingineering			
Educational Objectives	After taking part successf	fully, students have reach	ed the following learning	results	
Professional Competence	students can:				
Knowledge	classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilliation problems explain pfd-diagrams				
Skills	students are capable of  - formulation of mass and energy balance equations and estimation of product streams  - estimation of component streams of chemical plants using linear component balance models  - solution of data reconcilliation tasks  - conduction of process synthesis  - economic evaluation of processes and the estimation of production costs				
Personal Competence					
Social Competence					
Autonomy					
	Independent Study Time	124, Study Time in Lectu	re 56		
Credit points Studienleistung	Compulsory Bonus	Form Subject theoretical practical work	<b>Description</b> and		
Examination	Written exam				
Examination duration and scale	L120 Min. lectures notes a	and books			
Assignment for the Following Curricula		ence (German program): ience (German program ence (German program, Science (German program program) g: Elective Compulsory Core qualification: Comp	Specialisation Bioproces, 7 semester): Specialisation 8 semester 8 semes	es Engineeri ation Proces on Bioproce pecialisation	ng: Compulso ss Engineerin ss Engineerin n Energy ar



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

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

Process Engineering: Core qualification: Compulsory

Tvp	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	<ol> <li>Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants     </li> <li>Engineering methods and tools</li> <li>Mass and energy balances</li> <li>Strategies of process synthesis</li> <li>Graphical representation of processes</li> <li>Multidimensional regression</li> <li>Data reconciliation and data validation</li> <li>Process Synthesis</li> <li>Decision levels</li> <li>Experimental process development</li> <li>Reactor synthesis</li> <li>Synthesis of separation processes (process alternatives and criteria for selection)</li> <li>Integration of reaction systems/separation systems (interactions, recycle streams)</li> <li>Process safety</li> <li>Cost estimation of production plants</li> <li>Production costs, capital costs, economic evaluation</li> </ol>
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133



	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000	
Literature	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991	
Literature	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001	

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

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

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

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

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

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

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

P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534

G. Kaibel, Dissertation, TU München, 1987

G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112

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

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

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

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

Course L0096: Process and Plant Engineering I		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1214: Process	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		
Lecturer	Prof. Georg Fieg		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0829: Fo	undations of Management			
Courses				
Title  Management Tutorial (L088) Introduction to Management		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	I Racic Knowiadda of Wathamatice and Rijcina	SS		
	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	After taking this module, students know the in Management, from Planning and Organisation and Controlling. In particular they are able to	on to Marketing and Innovati	on, and als	o to Investmen
Knowledge	<ul> <li>explain the differences between Ec Management and to name important of explain the most important aspects of aspects of entreprneurial projects</li> <li>describe and explain basic business supply chain management, organized management, innovation management explain the relevance of planning an multiple objectives and uncertainty, Finance</li> <li>state basics from accounting and costi</li> </ul>	efinitions from the field of Mar and goals in Management ar s functions as production, p ation and human ressource t and marketing d decision making in Busine and explain some basic m	nagement and name the procurement management ss, esp. in sethods from	most importar and sourcing ent, information
Skills	Students are able to analyse business units strategies etc.) and to carry out an Entreprene   analyse Management goals and struct analyse organisational and staff struct apply methods for decision making un analyse production and procurements analyse and apply basic methods of meselect and apply basic methods from reapply basic methods from accounting,	urship project in a team. In parture them appropriately ures of companies der multiple objectives, under systems and Business informatarketing nathematical finance to prede	uncertainty tion system	y are able to and under risk s ms
Personal Competence				
Social Competence	work successfully in a team of student:     to apply their knowledge from the lec report on the project     to communicate appropriately and     to cooperate respectfully with their feller	ture to an entrepreneurship p	roject and v	vrite a coheren
Autonomy	Students are able to  work in a team and to organize the tea  to write a report on their project.	m themselves		
	Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek	
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 self-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.	



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

,	screte Algebraic Structure	s		
Courses				
<b>Title</b> Discrete Algebraic Structure Discrete Algebraic Structure		<b>Typ</b> Lecture Recitation Section (sr	Hrs/wk 2 mall) 2	<b>CP</b> 3 3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics from High School			
<b>Educational Objectives</b>	After taking part successfully, studer	nts have reached the following lear	rning results	
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic structures including elementary combinatorial structures, monoids, groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a group and to present the results accordingly			
Autonomy	Students are able to acquire new knowledge from specific standard books and to associate th acquired knowledge to other classes.			o associate the
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation I. Mathematics: Elective 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 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: Co	omputer Engineeri	ing			
Courses					
Title Computer Engineering (L032 Computer Engineering (L032			Typ Lecture Recitation Section (sm	Hrs/wk 3 nall) 1	<b>CP</b> 4 2
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	examination according t  1. Upon a passed marks due to the respectively, up t	etion of the labs will to the following rules:  module examination e successful labs, su to the next-better grace	If be honored during the student is granted that the examination's le.	a bonus on tl s marks are lift	ne examination's ed by 0,3 or 0,4
<b>Educational Objectives</b>	After taking part success	sfully, students have re	eached the following lear	ning 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-poin connections, busses				
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the interna 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 computer 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	Ct. danta are able to achie similar mable me along arising map to magnet the account to account male.				
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	e 124, Study Time in L	ecture 56		
Credit points	J	·			
Studienleistung	Compulsory Bonus	Form	Description	<u> </u>	



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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: 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, 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Computer 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: Ob	pjectoriented Programming, Algorith	ms and Data Struc	tures	
Courses				
Title		Тур	Hrs/wk	СР
	g, Algorithms and Data Structures (L0131) g, Algorithms and Data Structures (L0132)	Lecture Recitation Section (small)	4 1	4 2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
	Lecture Prozedurale Programmierung or equivale	ent proficiency in imperativ	e programm	ning
Recommended Previous Knowledge	<u> </u>			
	This remark is especially important for AIW, GES, curriculum. They are prerequisites for the start of IIW include those prerequisites in the first semeste.	those curricula in general	. The progra	ams ET, CI and
Educational Objectives	After taking part successfully, students have reach	ned the following learning	roculte	
Professional		led the following learning	resurts	
Competence	Students can explain the essentials of software reference to existing class libraries and design pa	tterns.		
Knowledge	of important algorithms for sorting and searching.  Students are able to			
Skills	<ul> <li>Design software using given design patter</li> <li>Carry out software development and tes         Test</li> <li>Sort and search for data efficiently</li> <li>Assess the complexity of algorithms.</li> </ul>			
Personal Competence				
Social Competence	Students can work in teams and communicate in f	orums.		
Autonomy	Students are able to solve programming tasks su and Google Test independently and over a period		sion using S	SVN Repositor
Workload in Hours	I Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points	<u> </u>			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	160 Minutes Content of Lecture, exercises and ma	terial in StudIP		



	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Technomathematics: Core qualification; Compulsory

Course L0131: Objectori	ented 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
	Object oriented analysis and design:  Objectoriented programming in C++ and Java generic programming UML design patterns  Data structures and algorithmes:  complexity of algorithms searching, sorting, hash tables, stack, queues, lists, trees (AVL, heap, 2-3-4, Trie, Huffman, Patricia, B), sets, priority queues, directed and undirected graphs (spanning trees, shortest and longest path)
Literature	Skriptum

Course L0132: Objectoriented Programming, Algorithms and Data Structures		
Тур	Recitation Section (small)	
Hrs/wk	1	
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	



ourses				
itle		Тур	Hrs/wk	СР
ignals and Systems (L0432	•	Lecture	3 2	4 2
ignals and Systems (L0433	·	Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is a (Fourier series, Fourier transform, Laplace tr	expected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional		- · · · ·		
Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific proble			
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	gram): Specialisation Process E gram): Specialisation Bioproces n program): Specialisation n program): Specialisation gram): Specialisation Biomedic ogram, 7 semester): Specialisa	Engineering: ss Engineerin Civil- and Mechanical al Engineerin tion Electric	Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	and Systems
Тур	Lecture
Hrs/wk	3
СР	-
	Independent Study Time 78, Study Time in Lecture 42
Lecturer Language	Prof. Gerhard Bauch
Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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			Тур	Hrs/wk	СР
Graph Theory and Optimiza			Lecture	2	3
Graph Theory and Optimiza			Recitation Section (sma	ll) 2	3
Module Responsible	Prof. Anusch Taraz				
Admission Requirements	None				
Recommended Previous Knowledge	<ul><li>Discrete Algebrai</li><li>Mathematics I</li></ul>	ic Structures			
Educational Objectives	After taking part success	fully, students have re	ached the following learni	ng results	
Professional Competence					
Knowledge	<ul> <li>Students can name the basic concepts in Graph Theory and Optimization. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable or illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>				
Skills	<ul> <li>Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>				
Personal Competence					
Social Competence	common languag  In doing so, they	je. can communicate ne	n teams. They are capal w concepts according to examples to check and dee	the needs of th	neir cooperating
Autonomy	can specify open  Students have de	questions precisely a	r understanding of comple and know where to get help rsistence to be able to wo	in solving the	m.
Workload in Hours	Independent Study Time	124, Study Time in L	ecture 56		
Credit points	6				
Studienleistung	None				
Examination	Written exam				
Examination duration and scale	120 min				
		cience (German pro	nm): Specialisation Compugram, 7 semester): Spec		



Assignment for the General Engineering Science (English program): Specialisation Computer Science: Compulsory Following Curricula General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective 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	<ul> <li>Graphs, search algorithms for graphs, trees</li> <li>planar graphs</li> <li>shortest paths</li> <li>minimum spanning trees</li> <li>maximum flow and minimum cut</li> <li>theorems of Menger, König-Egervary, Hall</li> <li>NP-complete problems</li> <li>backtracking and heuristics</li> <li>linear programming</li> <li>duality</li> <li>integer linear programming</li> </ul>		
Literature	<ul> <li>M. Aigner: Diskrete Mathematik, Vieweg, 2004</li> <li>J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007</li> <li>A. Steger: Diskrete Strukturen (Band 1), Springer, 2001</li> <li>A. Taraz: Diskrete Mathematik, Birkhäuser, 2012</li> <li>V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009</li> <li>KH. Zimmermann: Diskrete Mathematik, BoD, 2006</li> </ul>		

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



Module M0727: Sto	ochastics			
Courses				
Title		Тур	Hrs/wk	СР
Stochastics (L0777) Stochastics (L0778)		Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Calculus</li> <li>Discrete algebraic structures (combinatori</li> <li>Propositional logic</li> </ul>	cs)		
<b>Educational Objectives</b>	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques.			
Skills	Students can apply algorithms for solving decision problems, and they can justify whether			
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams (i.e., teams from different study programs and background knowledge) and to present their results appropriately (e.g. during exercise class).			
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They car specify open questions precisely and know where to get help in solving them.</li> <li>Students can put their knowledge in relation to the contents of other lectures.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>			
	enemed marrier on hard problems.			
	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points				
Studienleistung	None Written exam			
Examination duration				
and scale	120 min			
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory			



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

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	



Courses				
Γitle		Тур	Hrs/wk	СР
Automata Theory and Form	- ,	Lecture	2	4
Automata Theory and Form	al Languages (L0507)	Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
	Participating students should be able to			
	- specify algorithms for simple data structu	res (such as, e.g., arrays) to solv	e computation	nal problems
Recommended Previous Knowledge	- apply propositional logic and predicate lo	ngic for specifying and understa	nding mather	matical proofs
r revious Knowleage			_	natical proofs
	- apply the knowledge and skills taught in	the module Discrete Algebraic S	Structures	
Educational Objectives	After taking part successfully, students hav	e reached the following learning	g results	
Professional				
Competence	Students can explain syntax, semantics,			
Knowledge	able to give algorithms for solving decision problems. Students can show correspondences to Boolea algebra. Students can describe which application problems are hard to represent with propositional logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. The understand that some formalisms easily induce algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalism such as logic, automata, or grammars.			
Skills	Students can apply propositional logic as well as predicate logic resolution to a given set of formulas Students analyze application problems in order to derive propositional logic, predicate logic, of temporal logic formulas to represent them. They can evaluate which formalism is best suited for particular application problem, and they can demonstrate the application of algorithms for decision problems to specific formulas. Students can also transform nondeterministic automata into deterministic ones, or derive grammars from automata and vice versa. They can show how parser work, and they can apply algorithms for the language emptiness problem in case of infinite words.			
Personal Competence				
Social Competence				
Autonomy	Independent Or d. Tay 104 Or d. T.	in Lantina FO		
	Independent Study Time 124, Study Time	III Lecture 56		
Credit points				
Studienleistung	Written exam			
Examination duration				
and scale	90 min			
	General Engineering Science (German pro General Engineering Science (German Elective Compulsory			



# Assignment for the Following Curricula

Computer Science: Core qualification: Compulsory

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

Elective Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Flective Compulsory

Course L0332: Automat	a Theory and Formal Languages
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Tobias Knopp
Language	EN
Cycle	SoSe
Content	1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF 2. Predicate logic, unification, predicate logic resolution 3. Temporal Logics (LTL, CTL) 4. Deterministic finite automata, definition and construction 5. Regular languages, closure properties, word problem, string matching 6. Nondeterministic automata: Rabin-Scott transformation of nondeterministic into deterministic automata 7. Epsilon automata, minimization of automata, elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states) 8. Myhill-Nerode Theorem: Correctness of the minimization procedure, equivalence classes of strings induced by automata 9. Pumping Lemma for regular languages: provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be 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 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 (wo accepting states), infinite state sequences, automata networks 20. Omega automata: Automata for infinite input words, Büchi automata, reparsentation of state transition systems, verification w.r.t. temporal logic specifications (in particular LTL) 21. LTL safety conditions and model ch
Literature	Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.     Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006     Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.     Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007



Course L0507: Automata Theory and Formal Languages	
Тур	Recitation Section (small)
Hrs/wk	2
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: En	nbedded Systems				
Courses					
Title Embedded Systems (L0805 Embedded Systems (L0806			Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof Heiko Falk		,		
Admission Requirements					
Recommended Previous Knowledge	Computer Engineering				
	After taking part successfully,	students have reach	ed the following learning	g results	
Professional Competence					
Knowledge	Embedded systems can be products. This course teach introduction into these system (models of computation, his specification of real-time apple.  Another part covers the hards	nes the foundations ms (notions, commo grarchical automata, ications, translations	of such systems. In n characteristics) and t specification of distrib between different mode	particular, it heir specifica outed system els).	deals with a ation language s, task graph
	capable communication hardware, embedded processors, memories, energy dissipation reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded system using hardware/software co-design (hardware/software partitioning, high-level transformations specifications, energy-efficient realizations, compilers for embedded processors) is covered.				
Skills	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize 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 computations and feasible techniques for system-level design. They shall be able to judge in which areas of embedded system design specific risks exist.				
Personal Competence					
Social Competence	Students are able to solve sin	nilar problems alone	or in a group and to pre	sent the resu	Its accordingly
Autonomy	Students are able to acquire with other classes.	new knowledge from	n specific literature and	to associate	this knowledg
Workload in Hours	Independent Study Time 124,	Study Time in Lectu	re 56		
Credit points	6				
	. ,	rm	Description		
Studienleistung	10%	bject theoretical actical work	and		
Examination	Written exam				
Examination duration and scale	90 minutes, contents of course	e and labs			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory				



Course L0805: Embedde	ed Systems
Тур	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	<ul> <li>Introduction</li> <li>Specifications and Modeling</li> <li>Embedded/Cyber-Physical Systems Hardware</li> <li>System Software</li> <li>Evaluation and Validation</li> <li>Mapping of Applications to Execution Platforms</li> <li>Optimization</li> </ul>
Literature	<ul> <li>Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber- Physical Systems. 2<sup>nd</sup> Edition, Springer, 2012., Springer, 2012.</li> </ul>

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



Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (Li	0417)	Lecture	2	3
Numerical Mathematics I (Li	0418)	Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Stu II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	dents (german or english) <b>or</b> Ar	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence		5 5		
	Students are able to			
Knowledge	<ul> <li>name numerical methods for interproblems, nonlinear root finding prolements repeat convergence statements for the explain aspects for the practical exe and storage complexity.</li> </ul>	olems and to explain their core in numerical methods,	ideas,	
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			
Social Competence	<ul> <li>work together in heterogeneously cand background knowledge), explained practical aspects regarding the imple</li> </ul>	ain theoretical foundations an		
	Students are capable			
Autonomy	<ul> <li>to assess whether the supporting individually or in a team,</li> <li>to assess their individual progess an</li> </ul>	·		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Studienleistung				
	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German prog General Engineering Science (German p Biomechanics: Compulsory General Engineering Science (German p Materials in Engineering Sciences: Compuls General Engineering Science (German prog General Engineering Science (German p Compulsory	rogram): Specialisation Mecharogram): Specialisation Mecharogram sory gram): Specialisation Biomedica	anical Engi anical Engi al Engineeri	neering, Focu neering, Focu ng: Compulsor



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 Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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 Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

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



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



Module M0793: Se	minars Computer Science and	d Mathematics		
Courses				
Title Seminar Computational Mathematics/Computer Science (L0797) Seminar Computational Engineering Science (L0796) Seminar Engineering Mathematics/Computer Science (L1781)		<b>Typ</b> Seminar Seminar Seminar	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a rudimentary field of Computer Science Mathematics, or Engineering Science.			
Skills	The students are able to elaborate self-reliantly a rudimentary subfield of Computer Science Mathematics, or Engineering Science.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Studienleistung	None			
Examination	Presentation			
Examination duration and scale	Presentation 20 min and discussion 5 min.			
Assignment for the Following Curricula	General Engineering Science (German po General Engineering Science (German Compulsory Computer Science: Core qualification: Co General Engineering Science (English pr General Engineering Science (English	program, 7 semester): Sompulsory ogram): Specialisation Cor	Specialisation Con	nputer Science

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

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Compulsory



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	<ul> <li>Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering science are proposed by the organizer</li> <li>Active participation in discussions.</li> </ul>
Literature	Wird vom Seminarveranstalter bekanntgegeben.

Course L1781: Seminar	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	<ul> <li>Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering mathematics are proposed by the organizer</li> <li>Active participation in discussions.</li> </ul>		
Literature	Wird vom Seminarveranstalter bekanntgegeben.		



Module M0834: Co	omputernetworks and Inte	rnet Security		
Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Int	ernet Security (L1098)	Lecture	3	5
Computer Networks and Int	ternet Security (L1099)	Recitation Section (small	) 1	1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	INONA			
Recommended Previous Knowledge	Basics of Computer Science			
<b>Educational Objectives</b>	After taking part successfully, stude	ents have reached the following learning	ig results	
Professional Competence				
Knowledge		rtant and common Internet protocols i velop networked systems in further stu		classify them,
Skills	Students are able to analyse cor domains.	nmon Internet protocols and evaluate	the use of the	hem in differe
Personal Competence				
Social Competence				
Autonomy	Students can select relevant p independently learn and understal	arts out of high amount of profes nd it.	sional knowl	edge and ca
Workload in Hours	Independent Study Time 124, Stud	y Time in Lecture 56		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	1120 min			
Assignment for the Following Curricula	General Engineering Science (G Elective Compulsory Computer Science: Core qualificat Electrical Engineering: Core qualificat General Engineering Science (Engineering Engineering Science (Elective Compulsory		alisation Con er Science: Co alisation Con	nputer Scienco

Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory



Course L1098: Compute	r Networks and Internet Security
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann
Language	EN
Cycle	WiSe
Content	In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs.  In the second part of the lecture an introduction to Internet security is given.  This class comprises:  Application layer protocols (HTTP, FTP, DNS) Transport layer protocols (TCP, UDP) Network Layer (Internet Protocol, routing in the Internet) Data link layer with media access at the example of Ethernet Multimedia applications in the Internet Network management Internet security: IPSec Internet security: Firewalls
Literature	<ul> <li>Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley</li> <li>Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflage</li> <li>W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition</li> </ul> Further literature is announced at the beginning of the lecture.

Course L1099: Computer Networks and Internet Security	
Тур	Recitation Section (small)
Hrs/wk	1
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: Fu	nctional Program	ming			
Courses					
Title Functional Programming (L0624)		<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2	
Functional Programming (LC Functional Programming (LC			Recitation Section (large) Recitation Section (small)	2	2 2
	· •		necitation Section (Smail)	2	2
Module Responsible Admission					
Requirements	None				
Recommended Previous Knowledge	I I liccrata mathamatice at	t high-school level			
	<u>.                                    </u>	sfully, students have read	ched the following learning	results	
Professional Competence					
Knowledge	Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.				
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 peer. They defend their		ng peers. They explain prob ommunicate in English.	olems and s	olutions to their
Autonomy	In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") the mechanics of programming. In exercises, they develop solutions individually and independently, and receive feedback.				
Workload in Hours	Independent Study Time	e 96, Study Time in Lectu	ire 84		
Credit points	6				
Studienleistung	Compulsory Bonus Yes 15 %	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale	190 min				
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory				



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

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



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



Module M0791: Co	omputer Architectui	re			
Courses					
Title			Тур	Hrs/wk	СР
Computer Architecture (L07	93)		Lecture	2	3
Computer Architecture (L07	94)		Project-/problem-based Learning	2	2
Computer Architecture (L18	.64)		Recitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk				
Admission Requirements					
Recommended Previous Knowledge	Module "Computer Engine	eering"			
Educational Objectives	After taking part successfu	ully, students have reache	ed the following learning	results	
Professional Competence					
Knowledge	This module presents a beginning, a broad over computers and for specia	view over various progra al-purpose machines (e.g processors are covered ds used for the acceleratincepts for dynamic sched	amming models is given I., signal processors). Ne . Here, the focus particu on of instruction execution	, both for gext, foundation along the secondarial secondaria seco	eneral-purpose onal aspects of n the so-called his context. The
Skills	The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.				
Personal Competence					
Social Competence	Students are able to solve	e similar problems alone o	or in a group and to prese	ent the resu	Its 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 1	110, Study Time in Lectur	e 70		
Credit points	6				
01	Compulsory Bonus	Form	Description		
Studienleistung	No 15 %	Subject theoretical practical work	and		
Examination	Written exam	F			
Examination duration and scale	IQO minutes contents of co	ourse and 4 attestations fr	om the PBL "Computer a	rchitecture"	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory				



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

Course L0794: Computer Architecture		
Тур	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



courses					
Title Title		Тур	Hrs/wk	СР	
ntroduction to Control Syste ntroduction to Control Syste	•	Lecture Recitation Section (small)	2	4 2	
Module Responsible	Prof. Herbert Werner				
Admission Requirements	None				
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	rm	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results		
Professional Competence					
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequencesponse</li> <li>They can explain issues arising when controllers designed in continuous time domain a implemented digitally</li> </ul>				
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>				
Personal Competence					
Social Competence	Students can work in small groups to jo	pintly solve technical problems, a	nd experim	nentally valida	
Autonomy	their controller designs  Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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			
Credit points					
Studienleistung					
Examination					
Examination duration and scale	120 min				



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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	ViSe				
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 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	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>				



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 M0562: Co	omputability and Complexity	Theory			
Courses					
Title			Тур	Hrs/wk	СР
Computability and Complexit			Lecture	2	3
Computability and Complexit	ty Theory (L0167)		Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann				
Admission Requirements	None				
Recommended Previous Knowledge	Discrete Algebraic Structures, Automata	a Theory, Lo	ogic, and Formal Langua	ge Theory.	
<b>Educational Objectives</b>	After taking part successfully, students I	nave reache	ed the following learning	results	
Professional Competence					
Knowledge	The students known the important machine models of computability, the class of partial recursive functions, universal computability, Gödel numbering of computations, the theorems of Kleene, Rice and Rice-Shapiro, the concept 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.				
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.				
Personal Competence					
Social Competence					
Autonomy	Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes.				
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lectur	re 56		
Credit points	6				
Studienleistung	None				
Examination	Oral exam				
Examination duration and scale	20 min				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory				

Course L0166: Computa	ourse 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	Prof. 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	Prof. Karl-Heinz Zimmermann	
Language	DE/EN	
Cycle	SoSe	
Content		
Literature		



Module M0829: Fo	undations of Management			
Courses				
Title Management Tutorial (L0882) Introduction to Management (L0880)		<b>Typ</b> Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible				
Admission Requirements	· · · · · · · · · · · · · · · · · · ·			
Recommended Previous Knowledge		;		
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>describe and explain basic business supply chain management, organizati management, innovation management at explain the relevance of planning and multiple objectives and uncertainty, a Finance</li> <li>state basics from accounting and costing</li> </ul>	nomics and Management a finitions from the field of Mar nd goals in Management ar functions as production, p on and human ressource and marketing decision making in Busine and explain some basic m	and the sunagement and name the procurement managements, esp. in sethods from ethods.	b-disciplines in most important and sourcing ent, information situations under mathematical
Skills	Students are able to analyse business units wistrategies etc.) and to carry out an Entrepreneur.  analyse Management goals and structur. analyse organisational and staff structur. apply methods for decision making under analyse production and procurement sy analyse and apply basic methods of ma select and apply basic methods from ma apply basic methods from accounting, contains the structure and select and apply basic methods from accounting, contains the structure and select and apply basic methods from accounting, contains the structure and select and apply basic methods from accounting, contains the structure and select and apply basic methods from accounting, contains the structure analyse organisational and staff structure analyse organisational and staff structure.	rship project in a team. In pare them appropriately es of companies er multiple objectives, under stems and Business informarketing athematical finance to prede	uncertainty	y are able to and under risk s ems
Personal Competence				
Social Competence	Students are able to  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherer 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 to write a report on their project.	themselves		
	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Studienleistung	l,			
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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: Managen	nent Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
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 self-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.



urse L0880: Introduct	ion to Management				
	Lecture				
Hrs/wk	3				
СР	3				
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona				
Language	DE				
Cycle	WiSe/SoSe				
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>				
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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 M1269: La	b Cyber-Physical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Lab Cyber-Physical System	s (L1740)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Embedded Systems"			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	Cyber-Physical Systems (CPS) are tightly in A/D and D/A converters, and actors. Due sensors, processors and actors are conspecification approaches for CPS - in contrast Based on practical experiments using roundedling of CPS are taught. The lab	e to their particular application nmon. Accordingly, there is a ast to classical software engineed bot kits and computers, the b introduces into the area (bas	areas, high large varing approasasics of splice notions,	phly specialized iety of different aches. Decification and characteristica
Knowledge	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' experiments will base on simple control applications. The experiments will use state-of-the-all industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors.			
Skills	After successful attendance of the lab, stud interdependencies between a CPS and its interacts with the environment via sensor actors. The lab enables students to compar limitations, and to decide which technique techniques to practical problems. They development, in industry-relevant specificat	surrounding processes which st s, A/D converters, digital proce e modelling approaches, to eva to use for a concrete task. They obtain first experiences in	em from the essors, D/A duate their will be abl hardware-re	e fact that a CPS converters and advantages and e to apply these elated software
Personal Competence				
Social Competence	Students are able to solve similar problems	alone or in a group and to prese	ent the resu	Its accordingly.
Autonomy	Students are able to acquire new knowled with other classes.	ge from specific literature and to	o associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time ir	Lecture 56		
Credit points	<u> </u>			
Studienleistung	None			
Examination	Written elaboration			
Examination duration and scale	Execution and documentation of all lab exp	eriments		
Assignment for the Following Curricula	General Engineering Science (German p Elective Compulsory Computer Science: Specialisation Compute General Engineering Science (English p Elective Compulsory Computational Science and Engineering: S Computational Science and Engineering: S Compulsory Mechatronics: Specialisation Intelligent Sys Mechatronics: Specialisation System Desig	er and Software Engineering: Ele rogram, 7 semester): Speciali pecialisation Computer Science pecialisation Mathematics & En tems and Robotics: Elective Con	ective Comp sation Con E: Elective C gineering S	oulsory nputer Science compulsory



Course L1740: Lab Cyber-Physical 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	<ul> <li>Experiment 1: Programming in NXC</li> <li>Experiment 2: Programming the Robot in Matlab/Simulink</li> <li>Experiment 3: Programming the Robot in LabVIEW</li> </ul>			
Literature	<ul> <li>Peter Marwedel. Embedded System Design - Embedded System Foundations of Cyber-Physical Systems. 2<sup>nd</sup> Edition, Springer, 2012.</li> <li>Begleitende Foliensätze</li> </ul>			



Module M0732: So	ftware Engineering				
Courses					
Title				Hrs/wk	СР
Software Engineering (L062)	7)		Г <b>ур</b> Lecture	2	3
Software Engineering (L062)					
Module Responsible	Prof. Sibylle Schupp				
Admission Requirements	None				
Recommended Previous Knowledge	<ul><li>Automata theory and formal</li><li>Procedural programming or</li><li>Object-oriented programmir</li></ul>	r Functional progi	_		
<b>Educational Objectives</b>	After taking part successfully, stude	ents have reached	d the following learning	results	
Professional Competence					
Knowledge	Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write test cases for different test strategies and devise specifications or models using different notations, and critique both. They explain simple design patterns and the major activities in requirements analysis maintenance, and project planning.				
Skills	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, Stud	ly Time in Lecture	: 56		
Credit points					
Studienleistung	Compulsory Bonus Form Description				
Examination	Written exam				
Examination duration and scale	90 min				
	General Engineering Science (General Engineering Science (General Engineering Science (Elective Compulsory Computational Science and Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Engineering Science (Engine	ion: Compulsory inglish program, eering: Specialisa eering: Specialisa	7 semester): Speciali ation Computer Science ation Computer Science	sation Com	nputer Science:



Course L0627: Software	Engineering
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	<ul> <li>Object-Oriented Analysis and Design (Object Identification, UML Interaction Diagrams, UML Class Diagrams, Architectural Patterns)</li> <li>Testing (Blackbox Testing, Whitebox Testing, Control-Flow Testing, Data-Flow Testing, Testing in the Large)</li> <li>Maintenance and Evolution (Regression Testing, Reverse Engineering, Reengineering)</li> <li>Project Management (Blackbox Estimation Techniques, Whitebox Estimation Techniques, Project Plans, Gantt Charts, PERT Charts)</li> </ul>
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		



Module M0971: Op	perating Systems				
Courses					
Title		Тур	Hrs/wk	СР	
Operating Systems (L1153) Operating Systems (L1154)		Lecture Recitation Section (small)	2	3 3	
		necitation section (smail)		3	
Module Responsible Admission					
Requirements	None				
Recommended Previous Knowledge	<ul> <li>Object-oriented programming, algorithms, and data structures</li> <li>Procedural programming</li> <li>Experience in using tools related to operating systems such as editors, linkers, compilers</li> <li>Experience in using C-libraries</li> </ul>				
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional Competence					
Knowledge	Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms.				
Skills	Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment.				
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Studienleistung	None				
Examination	Written exam				
Examination duration and scale	90 min				
	General Engineering Science (German prog General Engineering Science (German prog Elective Compulsory Computer Science: Core qualification: Comp General Engineering Science (English progr General Engineering Science (English progresser) Elective Compulsory Computational Science and Engineering: Sp Computational Science and Engineering: Sp Technomathematics: Specialisation II. Inform	ogram, 7 semester): Speciali rulsory am): Specialisation Computer s ogram, 7 semester): Speciali ecialisation Computer Science ecialisation Computer Science	sation Com Science: Co sation Com :: Elective C	mputer Science: mpulsory mputer Science: ompulsory	



Course L1153: Operating	g Systems			
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	<ul> <li>Architectures for Operating Systems</li> <li>Processes</li> <li>Concurrency</li> <li>Deadlocks</li> <li>Memory organization</li> <li>Scheduling</li> <li>File systems</li> </ul>			
Literature	Operating Systems, William Stallings, Pearson International Edition     Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium			

Course L1154: Operatin	urse 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: Ma	athematical Statistics						
Courses							
Title  Mathematical Statistics (L13  Mathematical Statistics (L13	•	Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3	<b>CP</b> 4 2			
Module Responsible	Prof. Natalie Neumeyer						
Admission Requirements	None						
Recommended Previous Knowledge							
Educational Objectives	After taking part successfully, students have	reached the following learning	results				
Professional Competence							
Knowledge	<ul> <li>Students can describe basic concepts in Mathematical Statistics such as the substitution and Maximum-Likelihood methods for construction of estimators, optimal unfalsified estimators optimal tests for parametric probability distributions, sufficiency and completeness and their application to estimation and test problems, tests in normal distribution and confidence domains and test families. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>						
Skills	<ul> <li>Students can model problems in Mathematical Statistics with the help of the concepts studie in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are abl to critically evaluate the results.</li> </ul>						
Personal Competence							
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics a common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their coopera partners. Moreover, they can design examples to check and deepen the understanding of peers.</li> </ul>						
Autonomy	<ul> <li>Students are capable of checking the can specify open questions precisely</li> <li>Students have developed sufficient proviented manner on hard problems.</li> </ul>	and know where to get help in	solving the	m.			
Workload in Hours	I Independent Study Time 124, Study Time in	Lecture 56					
Credit points	<u> </u>						
Studienleistung	!						
Examination	Written exam						
Examination duration and scale	l 120 minutes						
	General Engineering Science (German p	rogram, 7 semester): Special	isation Con	nputer Science			



	Elective Compulsory	İ
Assignment for the	Computer Science: Specialisation Computational Mathematics: Elective Compulsory	ĺ
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Computer Science:	İ
	Elective Compulsory	İ
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory	İ
	Technomathematics: Specialisation I. Mathematics: Flective Compulsory	Ĺ

Course L1339: Mathema	atical 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	<ul> <li>Substitution and Maximum-Likelihood methods for construction of estimators</li> <li>Optimal unfalsified estimators</li> <li>Optimal tests for parametric probability distributions (Neymann-Pearson theory)</li> <li>Sufficiency and completeness and their application to estimation and test problems</li> <li>Tests in normal distribution (e.g. Student's test)</li> <li>Confidence domains and test families</li> </ul>
Literature	<ul> <li>V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley.</li> <li>L. Wasserman (2010). All of statistics: A concise course in statistical inference. Springer.</li> <li>H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner.</li> </ul>

Course 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 focus (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 focus.

Courses					
Title			Тур	Hrs/wk	CP
Embodiment Design and 3D	)-CAD (L	L0268)	Lecture	2	1
Mechanical Design Project	I (L0695	5)	Project-/problem-based Learning	3	2
Mechanical Design Project	II (L0592	2)	Project-/problem-based Learning	3	2
Team Project Design Metho	odology (	(L0267)	Project-/problem-based Learning	2	1
Module Responsible	Prof. [	Dieter Krause			
Admissior Requirements	None				
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Engineering Design</li> <li>Mechanics</li> <li>Fundamentals of Materials Science</li> <li>Production Engineering</li> </ul>				
Educational Objectives	After to	aking part successfully, students h	ave reached the following learning	g results	
Professiona Competence					
Knowledge	After passing the module, students are able to:  explain design guidelines for machinery parts e.g. considering load situation, materials an 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.				
	•	apply creativity techniques in tea	ims.		



Social Competence	<ul> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> <li>moderate the use of scientific methods,</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course.</li> </ul>	
Autonomy	Students are able  to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),  To solve engineering design tasks systematically.	
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140	
Credit points	6	
Studienleistung	Compulsory BonusFormDescriptionYesNoneWritten elaborationYesNoneWritten elaborationYesNoneWritten elaborationYesNoneWritten elaboration	
Examination	Written exam	
Examination duration and scale	L180	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Mechanical Engineering: 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	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system</li> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul>		
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>		



Course L0695: Mechanical Design Project I		
Тур	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	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts</li> <li>(bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>	
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>	

Course L 0502: Machanical Design Project II			
Course L0592: Mechanical Design Project II			
Тур	roject-/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	<ul> <li>Generation of sketches for functions and sub-functions</li> <li>Approximately calculation of shafts</li> <li>Dimension of bearings, screw connections and weld</li> <li>Generation of engineering drawings (assembly drawings, manufacturing drawing)</li> </ul>		
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag.  Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag.  Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag.  Einführung in die DIN-Normen, Klein, M., Teubner-Verlag.  Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.		



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



Module M0933: Fundamentals of Materials Science				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S	Science I (L1085)	Lecture	2	2
Fundamentals of Materials	Science II (Advanced Ceramic Materials, Polyme	rs and Lecture	2	2
Composites) (LU506)	cs of Materials Science (L1095)	Lecture	2	2
-	· · · ·	Locities		
	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge		hematics		
Educational Objectives	After taking part successfully, students have	reached the following lea	rning results	
Professional				
Competence	<b>:</b>			
Knowledge	The students have acquired a fundamenta describe this knowledge comprehensively issues of atomic structure, microstructure, mechanical properties. The students know materials and can identify relevant approach trace materials phenomena back to the under the students of the students of the students and can identify relevant approach trace materials phenomena back to the under the students of the	. Fundamental knowled, phase diagrams, phase about the key aspects tes for characterizing spe	ge here means e transformations, of characterization ecific properties. T	specifically the corrosion and on methods for hey are able to
Skills	The students are able to trace materials plaws of nature. Materials phenomena here and stiffness, chemical properties such as a solidification, precipitation, or melting. The conditions and the materials microstructure, the material's behavior.	refers to mechanical prop prrosion resistance, and t students can explain t	perties such as sta to phase transform he relation betwe	rength, ductility nations such a een processin
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	I 180 min			
and Soule	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	ram): Specialisation Bion ram): Specialisation Nava ram, 7 semester): Specia ram, 7 semester): Specia ogram, 7 semester): Sp	tion Mechanical nedical Engineerial Architecture: Co lisation Mechanical disation Biomedical	I Engineering ng: Compulsor ompulsory cal Engineering cal Engineering
	General Engineering Science (German	program, / semester	,. Specialisation	i ⊑nergy an



	Enviromental Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Energy and Enviromental
Following Curricula	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 Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective 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 of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider	
Language	DE	
Cycle	SoSe	
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7	



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



Courses				
Γitle	Тур		Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)	Lectu Recit	re ation Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung			
Admission Requirements				
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering	ering mechanics and	d thermodyr	namics.
Educational Objectives	After taking part successfully, students have reached the	following learning	results	
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the 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.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis o technical systems. The lecture enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems 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	JIndependent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the 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): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture 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, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory			



Naval Architecture: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0454: Fluid Mechanics			
Тур	ecture		
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	<ul> <li>Overview</li> <li>Physical/mathematical modelling</li> <li>Special phenomena</li> <li>Basic equations of fluid dynamics</li> <li>The turbulence problem</li> <li>One dimensional theory for inkompressibel flows</li> <li>One dimensional theory for kompressibel flows</li> <li>Flow over contours without friction</li> <li>Flow over contours with friction</li> <li>Flow through channels</li> <li>Simplified equations for three dimensional flow</li> <li>Special aspects of the numerical solution for complex flows</li> </ul>		
Literature	<ul> <li>Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006</li> <li>Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004</li> </ul>		

Course L0455: Fluid Mechanics				
Тур	Typ 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:	Mechanics	IV (Kinetics	II,	Oscillations,	Analytical	Mechanics,	Multibody
Systems)							

Courses		_				
Title	Ossillations Assolution 1 March	nion Multibarti C	Тур	Hrs/wk	СР	
(L1137)	Oscillations, Analytical Mechar		Lecture	3	3	
(L1130)	Oscillations, Analytical Mechar			2	2	
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechar	nics, Multibody Syst	Recitation Section (large)	1	1	
Module Responsible	Prof. Robert Seifried					
Admission Requirements	None					
Recommended Previous Knowledge	Mathematics I-III and Mecha	anics I-III				
	After taking part successfull	y, students have re	eached the following learning	results		
Professional Competence						
	The students can					
Knowledge	<ul><li>describe the axioma</li><li>explain important ste</li><li>present technical kn</li></ul>	eps in model desig	d in mechanical contexts; in;			
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;</li> <li>apply basic methods to engineering problems;</li> <li>estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.</li> </ul>					
Personal Competence	 			10		
Social Competence	The students can work in gr	oups and support	each other to overcome difficu	ulties.		
Autonomy	Students are capable of de and learning based on thos	•	n strengths and weaknesses	and to org	anize their time	
Workload in Hours	Independent Study Time 96	, Study Time in Le	cture 84			
Credit points	6					
Studienleistung	. ,	F <b>orm</b> Midterm	<b>Description</b> Wird nur im SoS	e angebote	n	
Examination	Written exam					
Examination duration and scale	120 min					
	Compulsory General Engineering Science General Engineering Science General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science	ce (German progra ce (German progra ce (German progra ce (German progra nce (German pro ce (English progra	program): Specialisation  am): Specialisation Biomedica am): Specialisation Naval Arcl am, 7 semester): Specialisatio  am, 7 semester): Specialisatio  gram, 7 semester): Specialisatio  gram, 7 semester): Specialisatio  m): Specialisation Mechanica m): Specialisation Biomedica	al Engineeri nitecture: Co on Mechanic on Biomedic isation Nav	ompulsory cal Engineering cal Engineering al Architecture ng: Compulsory	



Assignment for the	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory						
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:						
	Compulsory						
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:						
	Compulsory						
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:						
	Compulsory						
	Mechanical Engineering: Core qualification: Compulsory						
	Mechatronics: Core qualification: Compulsory						
	Naval Architecture: Core qualification: Compulsory						
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory						
	Technomathematics: Core qualification: Elective Compulsory						
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective						
	Compulsory						

Course L1137: Mechanic	cs 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	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</li> </ul>
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	Typ Recitation Section (small)					
Hrs/wk	Irs/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	Typ 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: Me	easurement Techn	ology for Mec	hanical and Process	Engineers	;
Courses					
Title Practical Course: Measuren Measurement Technology fo Measurement Technology fo	or Mechanical and Process E	Engineers (L1116)	Typ Practical Course Lecture Recitation Section (large	Hrs/wk 2 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Dr. Sven Krause				
Admission Requirements					
-	Basic knowledge of phys	sics, chemistry and	electrical engineering		
Educational Objectives	After taking part success	fully, students have	reached the following learni	ng results	
Professional Competence					
			mportant fundmentals of th ration, Static and Dynamic		
Knowledge	1/51 11 10	•	easuring methods for difference, mechanical quantities, Fl		
	They can describe imp Chromatography)	portant methods o	of chemical Analysis (Gas	Sensors, Spe	ctroscopy, G
Skills	Students can select suitable measuring methods to given problems and can use refering measurement devices in practice.  The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.				
Personal Competence	Students can arrive at work results in groups and document them in a common report.				
Social Competence		iliariza thamsalvas	with new measurement tech	pologies	
Autonomy				lologies.	
	Independent Study Time	110, Study Time in	Lecture 70		
Credit points	ļ	F	Do controller		
Studienleistung	Compulsory Bonus Form Description  Yes None Subject theoretical and practical work				
Examination	Written exam				
Examination duration and scale	l 105 minutes				
	Engineering: Compulsor General Engineering Compulsory General Engineering Sci General Engineering General Engineering Enviromental Engineerin General Engineering Sci Compulsory	Science (German pro ience (German pro ience (German pro Science (German ig: Compulsory ience (German pro	n program): Specialisation n program): Specialisation gram): Specialisation Biomeo gram): Specialisation Process n program, 7 semester): gram, 7 semester): Specialisa gram, 7 semester): Specialisa	n Mechanica lical Engineering: s Engineering: Specialisation	I Engineerin ng: Compulso Compulsory n Energy ar cal Engineerin



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

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



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					
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used.					
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement.					
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated.					
	Experiment 4:Identification of the parameters of a control system and optimal control parameters					
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmi Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.4</li> <li>Versuch 2:</li> </ul>					
Literature	<ul> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> </ul> Versuch 3:					
	<ul> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Ver Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989</li> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge</li> </ul>					



ourse L1116: Measure	ment Technology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Dr. Sven Krause
Language Cycle	
- Oyele	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
Content	2.6 Data Transmission
Comen	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.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springe 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978 3486217940.



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



Module M0865: Fu	ndamentals of Produc	tion and Quality Manageme	ent			
Courses						
Title	ration (1.000E)	Тур	Hrs/wk	СР		
Production Process Organia Quality Management (L0926)	,	Lecture Lecture	2 2	3 3		
Module Responsible	Prof. Hermann Lödding					
Admission Requirements	None					
Recommended Previous Knowledge	None					
<b>Educational Objectives</b>	After taking part successfully, s	tudents have reached the following le	arning results			
Professional Competence						
Knowledge	Students are able to explain the contents of the lecture of the module.					
	Students are able to apply the methods and models in the module to industrial problems.					
Personal Competence						
Social Competence						
Autonomy						
	Independent Study Time 124, S	Study Time in Lecture 56				
Credit points						
Studienleistung						
	Written exam					
Examination duration and scale	180 Minuten					
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Elective Compulsory					



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

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



Courses				
Γitle		Тур	Hrs/wk	СР
Electrical Machines (L0293) Electrical Machines (L0294)		Lecture Recitation Section (large)	3 2	4 2
	Prof. Thanh Trung Do			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of mathematics, in particular complexe nun Basics of electrical engineering and mechanical e	-	als	
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence		ou the femouring fourthing	recuite	
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 driver engine.			
Skills	Students arw able to calculate two-dimensional el circuits with air gap. For this they apply the usual number of the can calculate the operational performance of and selected quantities and characteristic curving graphical methods.	nethods of the design auf	electric mad	chines. aracteristic da
Personal Competence				
Personal Competence Social Competence				
Social Competence		formance of electric mach	nines from th	
Social Competence Autonomy	none Students are able independently to calculate ele able to analyse independently the operational per	formance of electric mach ities and characteristic cu	nines from th	
Social Competence Autonomy	none Students are able independently to calculate ele able to analyse independently the operational per data and theycan calculate thereof selected quant Independent Study Time 110, Study Time in Lectu	formance of electric mach ities and characteristic cu	nines from th	
Social Competence  Autonomy  Workload in Hours	none Students are able independently to calculate eleable to analyse independently the operational per data and theycan calculate thereof selected quant Independent Study Time 110, Study Time in Lectu 6	formance of electric mach ities and characteristic cu	nines from th	
Social Competence  Autonomy  Workload in Hours  Credit points  Studienleistung	none Students are able independently to calculate eleable to analyse independently the operational per data and theycan calculate thereof selected quant Independent Study Time 110, Study Time in Lectu 6	formance of electric mach ities and characteristic cu	nines from th	
Social Competence  Autonomy  Workload in Hours  Credit points  Studienleistung	none Students are able independently to calculate eleable to analyse independently the operational per data and theycan calculate thereof selected quant  Independent Study Time 110, Study Time in Lectu  6 None Written exam	rformance of electric mach tities and characteristic cu re 70	nines from th	e charactersi



Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

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

ourse L0293: Electrica	I Machines
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thanh Trung Do
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 de Bibliothek der TUHH: ETB 313  Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatu 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. Thanh Trung Do, Weitere Mitarbeiter	
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"	



Maradada Moood A	learner d Malardalla			
Module M0934: Ad	Ivanced Materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Charac	terization (L1087)	Lecture	2	2
Advanced Materials Design	,	Lecture	2	2
Advanced Materials Design	(L1092)	Recitation Section (large)	2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science (I and II)			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional		<u> </u>		
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				
	The students are able to present solutions to spe	ecialists and to develop idea	as further.	
Social Competence				
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 Lect	ıre 84		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German prograticompulsory General Engineering Science (German program Elective Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Elective Compulsory Machanical Engineering: Core qualification: Elective Compulsory	n, 7 semester): Specialisationm): Specialisation Mechan, 7 semester): Specialisatio	on Mechanic	cal Engineering

Mechanical Engineering: Core qualification: Elective Compulsory



Course L1087: Advanced Materials 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.

Module M0597: Advanced Mechanical Engineering Design				
Courses				
		_		
Title	pooring Docign II (I 0264)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Advanced Mechanical Engin Advanced Mechanical Engin		Recitation Section (large)	2	1
Advanced Mechanical Engin		Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	After passing the module, students are able to:  explain complex working principles and functions of machine elements and of basic elements of fluidics,  explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,  indicate the background of dimensioning calculations.			
Skills	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss methods.	technical information in the lectur	re supporte	d by activating
Autonomy				
Workload in Hours	Independent Study Time 68, Study Time	e in Lecture 112		
Credit points	<u> </u>			
Studienleistung				
	Written exam			
Examination duration				
and scale				
	General Engineering Science (Germa	n program): Specialisation Mecha	anical Engi	neering, Focus



Energy Systems: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus

Aircraft Systems Engineering: Compulsory

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



ourse L0264: Advance	d Mechanical 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	
	Advanced Mechanical Engineering Design I & II	
Content	Fundamentals of the following machine elements:	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>	



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: Advance	d Mechanical 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
	Advanced Mechanical Engineering Design I & II
Content	Fundamentals of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



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: ME	D I: Introduction to Anatomy			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Anatomy (L03	384)	Lecture	2	3
Module Responsible	Prof. Udo Schumacher			
Admission	None			
Requirements Recommended				
Previous Knowledge	None			
Educational Objectives	After taking part successfully, students ha	ave reached the following le	earning results	
Professional				
Competence	The students can describe basel structu	uros and functions of intern	al argans and the	musaulaskalata
Knowledge	The students can describe basal structu system.	nes and functions of interna	ai organs and the i	nusculoskeleta
Milowieage	The students can describe the basic made	croscopy and microscopy of	those systems.	
Skills	The students can recognize the relation some common diseases; they can expla of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in currer professional level.	nt discussions in biomedic	cal research and	medicine on a
Autonomy	The students are able to access a conversations on the topic and acquire the			participate ir
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Studienleistung				
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focusion Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor 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, Focusion Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



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



gnals and Systems			
	Тур	Hrs/wk	СР
2)	Lecture	3	4
3)	Recitation Section (small)	2	2
Prof. Gerhard Bauch			
None			
Mathematics 1-3			
covered by the moduls Mathematik 1-3 is e	xpected. Further experience w	ith spectral	-
After taking part successfully, students have	reached the following learning	results	
methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both	ey are able to apply the fund and systems. They can describe time and image domain. In par	amental tra e and analy ticular, they	nsformations o se deterministio understand the
using methods of signal and system theory important properties such as magnitude and	<ul> <li>They can analyse and design design of the control of</li></ul>	n basic sys earity etc T	tems regarding
The students can jointly solve specific proble	ems.		
control their level of knowledge during the			•
-	Lecture 70		
90 min			
General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces on program): Specialisation on program): Specialisation on program): Specialisation Biomedical gram, 7 semester): Specialisation or gram,	Science: Congineering: s Engineering: s Engineering: s Engineering: s Engineering: Mechanical Engineering: sation Electrical sation Condition Processon Bioprocesson	ompulsory Compulsory ng: Compulsory Enviromenta I Engineering ng: Compulsory al Engineering nputer Science as Engineering ss Engineering
	Prof. Gerhard Bauch  None  Mathematics 1-3  The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is et (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series, Fourier transform, Laplace tree (Fourier series) and described and system theory. The continuous-time and discrete-time signals as signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal.  The students are able to describe and analyusing methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal properties to the students are able to acquire relevant control their level of knowledge during the clicker system.  Independent Study Time 110, Study Time in 6  None  Written exam  90 min  General Engineering Science (German prog General Engine	Prof. Gerhard Bauch  None  Mathematics 1-3  The modul is an introduction to the theory of signals and systems. Goo covered by the moduls Mathematik 1-3 is expected. Further experience we (Fourier series, Fourier transform, Laplace transform) is useful but not required that taking part successfully, students have reached the following learning.  The students are able to classify and describe signals and linear time-immethods of signal and system theory. They are able to apply the fund continuous-time and discrete-time signals and systems. They can describe signals and systems mathematically in both time and image domain. In par effects in time domain and image domain which are caused by the transignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and designal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and disignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and disignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and discrete-time signal to a fine theory. They can analyse and designing reporties such as magnitude and phase response, stability, line the impact of LTI systems on the signal properties in time and frequency dors.  The students can jointly solve specific problems.  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate life control their level of knowledge during the lecture period by solving tutoric clicker system.  Independent Study Time 110, Study Time in Lecture 70  6  None  Written exam  90 min  General Engineering Science (German program): Specialisation Electrical former and Engineering Science (German program): Specialisation Bioproces and Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Special	Typ Hrs/wk Lecture 3 Recitation Section (small) 2  Prof. Gerhard Bauch None  Mathematics 1-3  The modul is an introduction to the theory of signals and systems. Good knowled covered by the moduls Mathematik 1-3 is expected. Further experience with spectral (Fourier series, Fourier transform, Laplace transform) is useful but not required.  After taking part successfully, students have reached the following learning results  The students are able to classify and describe signals and linear time-invariant (LTI methods of signal and system theory. They are able to apply the fundamental transforming and discrete-time signals and systems. They can describe and analysignals and systems mathematically in both time and image domain. In particular, they effects in time domain and image domain which are caused by the transition of a signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-inusing methods of signal and system theory. They can analyse and design basic system performance and image domain and image domain which are caused by the transition of a signal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-inusing methods of signal and system theory. They can analyse and design basic system properties such as magnitude and phase response, stability, linearity etc The impact of LTI systems on the signal properties in time and frequency domain.  The students can jointly solve specific problems.  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature soluctors system.  Independent Study Time 110, Study Time in Lecture 70  6  None  Written exam  90 min  General Engineering Science (German program): Specialisation Process Engineering Ceneral Engineering Science (German program): Specialisation Bioprocess Engineering Ceneral Engineering Science (German program): Specialisation Biomedical Engineering Ceneral Engineering S



Focus Biomechanics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: Compulsory

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

Constal Engineering Science (Cormon program 7 oc

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

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

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	and Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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 				
<b>Title</b> Introduction to Radiology an	d Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Prof. Ulrich Carl			
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, stude	nts have reached the following le	earning results	
Professional Competence			<u> </u>	
	Therapy The students can distinguish diffe radiation therapy. The students can explain treatmen surgery, internal medicine).			
	The students can describe the pa care.	tients' passage from their initia	al admittance thro	ugh to follow-u
	Diagnostics			
Knowledge	The students can illustrate the angiography and mammography, a			
	The students can explain the diagr the technical basis for those technic		of imaging technic	ques, as well a
	The students can choose the right needs.	treatment method depending of	on the patient's clir	ical history an
	The student can explain the influen	ce of technical errors on the imag	ging techniques.	
	The student can draw the right coprotocol.	onclusions based on the image	es' diagnostic findir	ngs or the erro
	Therapy The students can distinguish cura conclusion.	tive and palliative situations an	d motivate why the	ey came to the
	The students can develop adequate	e therapy concepts and relate it t	o the radiation biol	ogical aspects.
	The students can use the therapeut	ic principle (effects vs adverse e	ffects)	
	The students can distinguish differ situation (location of the tumor) and			
Skills	The student can assess what an treatment, sports, social help group			
	Diagnostics			
	The students can suggest solution analyses.	ns for repairs of imaging instru	mentation after ha	ving done erro
	The students can classify results based on their knowledge of anator		-	ups of disease
Personal Competence				
-	The students can assess the spec	cial social situation of tumor pa	tients and interact	with them in
	professional way.			



	diagnostic and therapeutic 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 topic and acquire the relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Studienleistung	None
Examination	Written exam
Examination duration and scale	190 minutes
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General 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



Typ	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring
Language	
Cycle Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. I 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	<ul> <li>"Technik der medizinischen Radiologie" von T. + J. Laubenberg – 7. Auflage – Deutscher Ärzteverlag – erschienen 1999</li> <li>"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – 4. Auflage - Verlag Urban &amp; Fischer – erschienen 02.03.2006</li> <li>ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg – erschienen 08.12.2009</li> <li>ISBN: 978-3-437-47501-6</li> <li>"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012</li> <li>ISBN: 978-3-13-567708-8</li> <li>"Der Körper des Menschen " von A. Faller u. M. Schünke - 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012</li> <li>ISBN: 978-3-13-329716-5</li> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer – 1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000</li> </ul>



Courses					
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032			Typ Lecture Recitation Section (sma	Hrs/wk 3 all) 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge	examination according to  1. Upon a passed marks due to the respectively, up to	etion of the labs wi to the following rules: module examination e successful labs, su to the next-better grad	n, the student is granted a	a bonus on th marks are lift	ne examination' ed by 0,3 or 0,4
<b>Educational Objectives</b>	After taking part success	fully, students have r	eached the following learn	ing results	
Professional Competence					
Competence	This module deals with	the foundations of th	e functionality of computin	a eveteme It a	covere the laver
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architectur pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poi connections, busses</li> </ul>				
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the interestructure and the physical composition of computer systems. The students can analyze, how hig specific and individual computers can be built based on a collection of few and simple componer. They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors.  Solution After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they should 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.		lyze, how highly ple components ayers of today' terdependencie cular, they sha entric abstraction to evaluate the		
Personal Competence					
Social Competence	Students are able to solv	ve similar problems a	lone or in a group and to p	resent the resi	ults accordingly.
Autonomy	Students are able to accomit other classes.	quire new knowledge	e from specific literature ar	nd to associate	e this knowledge
Workload in Hours	Independent Study Time	e 124, Study Time in I	_ecture 56		
Credit points		-			
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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: 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: Compute	r 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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				
Title		Тур	Hrs/wk	СР
ntroduction to Biochemistry	and Molecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, students	s have reached the following le	earning results	
Professional Competence		<u> </u>		
Knowledge	<ul> <li>describe basic biomolecules;</li> <li>explain how genetic informatio</li> <li>explain the connection between</li> </ul>			
Skills	<ul> <li>The students can</li> <li>recognize the importance of m</li> <li>describe selected molecular-c</li> <li>explain the relevance of these</li> </ul>	liagnostic procedures;		
Personal Competence				
Social Competence	The students can participate in discus	ssions in research and medicir	ne on a technical lev	/el.
Autonomy	The students can develop understathemselves.	nding of topics from the cou	urse, using technica	al literature, b
Workload in Hours	Independent Study Time 62, Study Time	me in Lecture 28		
Credit points	3			
Studienleistung				
	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following Curricula				



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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		
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage	
Literature	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008	



Courses				
<b>Title</b> Numerical Mathematics I (L' Numerical Mathematics I (L'	•	Typ Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
•	Prof. Sabine Le Borne	· · ·		
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Stud II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	ents (german or english) <b>or</b> Ar	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>name numerical methods for interportation problems, nonlinear root finding problems repeat convergence statements for the explain aspects for the practical exect and storage complexitx.</li> </ul>	ems and to explain their core in the income	deas,	-
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				
Social Competence	work together in heterogeneously co and background knowledge), explai practical aspects regarding the impler	n theoretical foundations an		
Autonomy	Students are capable  • to assess whether the supporting theoretical and practical excercises are better solved.			
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German progr General Engineering Science (German progr Biomechanics: Compulsory General Engineering Science (German progr Materials in Engineering Sciences: Compulsor General Engineering Science (German progr General Engineering Science (German progr Compulsory	ogram): Specialisation Mechangram): Specialisation Mechangram ory am): Specialisation Biomedica	anical Engi anical Engi al Engineeri	neering, Focuneering, Focung: Compulso



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 Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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,

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

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

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



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



ns (L0654) ns (L0655) Prof. Herbert Werner Jone Representation of signals and syste	Typ Lecture Recitation Section (small) ems in time and frequency domain, Lapl	Hrs/wk 2 2	<b>CP</b> 4 2
rof. Herbert Werner  Jone	Recitation Section (small)	2	
lone	ems in time and frequency domain, Lapl	laco transfor	
	ems in time and frequency domain, Lapl	lago transfor	
Representation of signals and syste	ems in time and frequency domain, Lapl	laga transfor	
		iace transion	m
fter taking part successfully, stude	nts have reached the following learning	results	
<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
=	s to jointly solve technical problems, a	and experim	nentally validat
students can obtain information xperiment guides) and use it wher	n solving given problems.		
ndenendent Study Time 124 Study	/ Time in Lecture 56		
	Time III Lectule 30		
th Se T	particular explain properties  They can explain the dynaterms of frequency response They can explain the Nyquis They can explain the role of They can explain the way response They can explain issues a implemented digitally  Students can transform modice versa They can simulate and asse They can design PID control They can analyze and sy frequency response techniq They can calculate discrete and use it for digital implemented and use it for digital implemented and use it was standard softwasks  Students can work in small groups their controller designs Students can obtain information experiment guides) and use it when they can assess their knowledge in the control of the co	<ul> <li>particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and inte terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability marg.</li> <li>They can explain the role of the phase margin in analysis and synthen they can explain the way a PID controller affects a control loor response</li> <li>They can explain issues arising when controllers designed in complemented digitally</li> <li>Students can transform models of linear dynamic systems from time vice versa</li> <li>They can simulate and assess the behavior of systems and control</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Notate the control loops with the frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers dependency response techniques</li> <li>They can use standard software tools (Matlab Control Toolbox, Sintasks)</li> <li>Students can work in small groups to jointly solve technical problems, at their controller designs</li> <li>Students can obtain information from provided sources (lecture note: experiment guides) and use it when solving given problems.</li> <li>They can assess their knowledge in weekly on-line tests and thereby controller designs</li> <li>Independent Study Time 124, Study Time in Lecture 56</li> <li>None</li> <li>Written exam</li> <li>General Engineering Science (German program): Core qualification: Complement and program and</li></ul>	particular explain properties of first and second order systems  They can explain the dynamics of simple control loops and interpret dynam terms of frequency response and root locus  They can explain the Nyquist stability criterion and the stability margins derived  They can explain the role of the phase margin in analysis and synthesis of cont  They can explain the way a PID controller affects a control loop in terms response  They can explain issues arising when controllers designed in continuous ti implemented digitally  Students can transform models of linear dynamic systems from time to frequency ice 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) tunin  They can analyze and synthesize simple control loops with the help of frequency response techniques  They can calculate discrete-time approximations of controllers designed in and use it for digital implementation  They can use standard software tools (Matlab Control Toolbox, Simulink) for cat tasks  Students can work in small groups to jointly solve technical problems, and experiment guides) and use it when solving given problems.  They can assess their knowledge in weekly on-line tests and thereby control their learn landependent Study Time 124, Study Time in Lecture 56  None  Written exam



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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 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
	Introduction to Matlab, Simulink, Control toolbox
Literature	<ul> <li>Computer-based exercises throughout the course</li> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses			
<b>Title</b> Implants and Fracture Heali	ng (L0376)	<b>Typ</b> Lecture	Hrs/wk CP 2 3
Module Responsible	Prof. Michael Morlock		
Admission Requirements	None		
Recommended Previous Knowledge	It is recommended to participate in "I Fracture Healing".	ntroduction into Anatomie	" before attending "Implants an
Educational Objectives	After taking part successfully, students ha	ave reached the following l	earning results
Professional Competence Knowledge	The students can describe the difference existence.  The students can name different treatre	•	·
	morphologies.  The students can determine the forces under specific assumptions.		
Personal Competence			
Social Competence	The students can, in groups, solve basic	numerical modeling tasks	for the calculation of internal forces
Autonomy	The students can, in groups, solve basic	numerical modeling tasks	for the calculation of internal forces
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28	
Credit points	3		
Studienleistung	None		
Examination	Written exam		
Examination duration and scale	90 min		
_	General Engineering Science (German program): Specialisation Mechanical Engineering, Fi Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compul General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineer Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compuls General Engineering Science (English program): Specialisation Mechanical Engineering, Fi Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineer Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Ele Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compul Biomedical Engineering: Specialisation III. Engineering Science: Elective Compulsory		omedical Engineering: Compulsor sialisation Mechanical Engineering cialisation Biomedical Engineering omedical Engineering: Compulsor Mechanical Engineering, Focusialisation Mechanical Engineering cialisation Biomedical Engineering Regenerative Medicine: Electives: Elective Compulsory ontrol Theory: Elective Compulsor Business Administration: Elective Compulsor



ourse L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Michael Morlock
Language Cycle	
	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)
Content	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
	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
Literature	Nigg, B.: Biomechanics of the musculo-skeletal system
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat



Module M1280: ME	:D II: Introduction to Physiolog	ЭУ		
Courses		T	Non-fords	O.D.
Title Introduction to Physiology (L	.0385)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
	Dr. Roger Zimmermann			
Admission				
Requirements	Notice			
Recommended Previous Knowledge	None			
	After taking part successfully, students ha	ve reached the following le	arning results	
Professional Competence				
Knowledge	<ul> <li>The students can</li> <li>describe the basics of the energy</li> <li>describe physiological relations sensory physiology.</li> </ul>		cle, heart/circulation	on, neuro- and
Skills	The students can describe the effects of of information, development of forces and		-	
Personal Competence				
Social Competence	The students can conduct discussions in The students can find solutions to probler			d metrological.
Autonomy	The students can derive answers to questions arising in the course and other physiological areas, using technical literature, by themselves.			
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Studienleistung				
Examination	Written exam			
Examination duration and scale				
_	General Engineering Science (German program): Specialisation Mechanical Engineering, Focialisation Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



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



Module M0829: Fo	undations of Management			
Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882 Introduction to Management	•	Recitation Section (large) Lecture	2	3 3
Module Responsible				
Admission Requirements	<u> </u>			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	After taking this module, students know the			
Knowledge	Management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to  • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management  • explain the most important aspects of and goals in Management and name the most important aspects of entrepreneurial projects			
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry 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 ris  • 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  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherence.		write a coherer	
Autonomy	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 i	n Lecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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: Managen	nent Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek
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 self-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.



ourse L0880: Introduct	ion 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	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>		
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003  Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.  Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.  Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttg 2008.  Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgeme 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 M1332: BIG	O I: Experimental Methods i	n Biomechanics		
	, , , , , , , , , , , , , , , , , , ,			
Courses				
<b>Title</b> Experimental Methods in Bio	omechanics (L0377)	<b>Typ</b> Lecture	<b>Hrs/wk CP</b> 2 3	
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "Methoden".	Implantate und Frakturheilung"	before attending "Experime	entelle
Educational Objectives	After taking part successfully, students	s have reached the following lea	arning results	
Professional Competence				
Knowledge	The students can describe the difference. The students can name different tremorphologies. The students can describe different in the adequate technique for a given ta	eatments for the spine and ho	llow bones under given fra	acture
Skills	The students can describe the b biomechanics.	asic handling of several ex	perimental techniques us	ed ir
Personal Competence				
Social Competence	The students can, in groups, solve ba	sic experimental tasks.		
Autonomy	The students can, in groups, solve ba	sic experimental tasks.		
Workload in Hours	Independent Study Time 62, Study Ti	me in Lecture 28		
Credit points				
Studienleistung				
Examination	Written exam			
Examination duration and scale	90 min			
_	General Engineering Science (German program): Specialisation Mechanical Engineering, Fo Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsing General Engineering Science (English program): Specialisation Mechanical Engineering, Fo Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compuls Biomedical Engineering: Specialisation Management and Business Administration: Electompulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		ulsory eering ulsory Focus eering eering	



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



### **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.

Courses					
Title Computer Engineering (L032 Computer Engineering (L032	·	Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3	<b>CP</b> 4 2	
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results		
Professional Competence	This module deals with the foundations of from the assembly-level programming dow		-	-	
Knowledge	<ul> <li>Introduction</li> <li>Combinational logic: Gates, Bode combinational networks</li> <li>Sequential logic: Flip-flops, automated Technological foundations</li> <li>Computer arithmetic: Integer additions</li> <li>Basics of computer architecture pipelining</li> <li>Memories: Memory hierarchies, SR</li> <li>Input/output: I/O from the perspect connections, busses</li> </ul>	olean algebra, Boolean function ta, systematic hardware design on, subtraction, multiplication and Programming models, MIPS	ions, hardv d division single-cyc	vare synthes	
	The students perceive computer systems f structure and the physical composition of specific and individual computers can be They are able to distinguish between a computing systems - from gates and circuit	computer systems. The studen built based on a collection of fe and to explain the different ab	ts can analy w and simp	yze, how high le componen	
Skills	After successful completion of the modu between a physical computer system a understand the consequences that the ex- layers from the assembly language down	nd the software executed on ecution of software has on the h	it. In partic ardware-ce	ular, they sh ntric abstracti	



	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
Studienleistung	Compulsory Bonus Form Description Yes 10 % Excercises
Examination	Written exam
Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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
Assignment for the Following Curricula	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: 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

Γ	
Course L0321: Compute	er 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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	



Modulo M0672: Sid	gnals and Systems					
Module Moorz. Sig	gnais and Systems					
Courses						
Title		Тур	Hrs/wk	СР		
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (small)	3 2	4 2		
Module Responsible	Prof. Gerhard Bauch					
Admission Requirements	None					
•	Mathematics 1-3					
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is exp (Fourier series, Fourier transform, Laplace transform, Laplace transform)	ected. Further experience w	ith spectral			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results			
Professional						
Competence						
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.					
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. 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						
Social Competence	The students can jointly solve specific problems.					
Autonomy	The students are able to acquire relevant in control their level of knowledge during the leadicker system.			-		
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70				
Credit points	6					
Studienleistung	None					
Examination	Written exam					
Examination duration and scale	19() min					
	General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory	am): Specialisation Computer (m): Specialisation Process E (m): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation (m): Specialisation Biomedica (am, 7 semester): Specialisation (gram, 7 semester): Specialisation (a	Science: Congineering: s Engineering:  ompulsory Compulsory ng: Compulsory Enviromenta Engineering ng: Compulsory al Engineering uputer Science as Engineering as Engineering as Engineering			
		,,		3 29		



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

**Following Curricula** 

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

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Assignment for the Electrical Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	and Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
Lecturer Language	Prof. Gerhard Bauch
Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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		Тур	Hrs/wk	СР				
Heat Transfer (L0458) Heat Transfer (L0459)		Lecture Recitation Section (large)	3 2	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 following learning	results					
Professional Competence								
	The students are able to							
	- describe the different physical mechanism	of Heat Transfer,						
Knowledge	- explain the technical terms,							
	- to analyse comlex heat transfer processes	in a critical way.						
	The students are able to							
	- understand the physics of Heat Transfer,							
Skills	- calculate and evaluate complex Heat Transfer processes,							
- solve excersises self-consistent and in small groups.								
Personal Competence								
Social Competence	The students are able to discuss in small groups and develop an approach.							
Autonomy	The students are able to develop a complex problem self-consistent and analyse the results in 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							
Studienleistung	None							
	Written exam							
Examination duration and scale	120 min							
	General Engineering Science (German programmer) General Engineering Science (German programmer) General Engineering Science (German programmer) General Engineering Science (German programmer) Theoretical Mechanical Engineering: Companies Companies (German programmer) General Engineering Science (German profrocus Energy Systems: Compulsory	orogram): Specialisation Mech gram): Specialisation Biomedica program): Specialisation Mech ulsory	anical Engi al Engineeri anical Engi	neering, Focung: Compulso				
Assignment for the Following Curricula	General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Compulsory General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English progeneral Engineering Science (E	Compulsory gram, 7 semester): Specialisation gram): Specialisation Biomedica grogram): Specialisation Mech	on Biomedio I Engineerir anical Engi	cal Engineering: Compulson				



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

Course L0458: Heat Tra	nsfer
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	<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996</li> </ul>

Course L0459: Heat Transfer		
Тур	Recitation Section (large)	
Hrs/wk	2	
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	



Courses								
Γitle				Тур	Hrs/wk	СР		
Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)				Lecture Recitation Section (small)	2 2	4 2		
Module Responsible	Prof. Herbert	Werner						
Admission Requirements	None							
Recommended Previous Knowledge	-	on of signals and s	systems in time and	d frequency domain, Lap	lace transfor	rm		
Educational Objectives	After taking pa	art successfully, st	udents have reach	ed the following learning	g results			
Professional Competence								
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>							
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain ar vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>							
Personal Competence								
Social Competence		_	oups to jointly sol	ve technical problems,	and experim	nentally valida		
Autonomy	their controller designs  Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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 S	Study Time in Lectu	re 56				
Credit points		,						
Studienleistung	ļ							
	Written exam							
Examination duration and scale								



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	
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 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
	<ul> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	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: Ac	Ivanced Mechanical Engineering	Design			
Courses					
Title Advanced Mechanical Engir Advanced Mechanical Engir Advanced Mechanical Engir	neering Design II (L0265)	Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 2 2	<b>CP</b> 2 1 2	
Advanced Mechanical Engir		Recitation Section (large)	2	1	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Engine</li> <li>Mechanics</li> <li>Fundamentals of Materials Science</li> <li>Production Engineering</li> </ul>	ering Design			
<b>Educational Objectives</b>	After taking part successfully, students have a	reached the following learning	results		
Professional Competence					
Knowledge	After passing the module, students are able t     explain complex working principles a of fluidics,     explain requirements, selection criticomplex machine elements,     indicate the background of dimension	and functions of machine elem			
Skills	After passing the module, students are able to: <ul> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solving skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>				
Personal Competence					
Social Competence	Students are able to discuss techr methods.	nical information in the lectu	re supporte	d by activating	
Autonomy	<ul> <li>Students are able to independently d</li> <li>Students are able to acquire additi content e.g. by using the video record</li> </ul>	onal knowledge and to reca			
Workload in Hours	Independent Study Time 68, Study Time in L	ecture 112			
Credit points	6				
Studienleistung	None				
Examination	Written exam				
Examination duration and scale	120				
	General Engineering Science (German pr Energy Systems: Compulsory General Engineering Science (German pr Aircraft Systems Engineering: Compulsory General Engineering Science (German pr Materials in Engineering Sciences: Compuls General Engineering Science (German pr Mechatronics: Compulsory General Engineering Science (German pr	rogram): Specialisation Mech rogram): Specialisation Mech ory rogram): Specialisation Mech	anical Engi anical Engi anical Engi	neering, Focus	



Product Development and Production: Compulsory

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

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

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

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

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

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

### Assignment for the Following Curricula

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

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

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

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

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

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



	d Mechanical 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			
	Advanced Mechanical Engineering Design I & II			
Content	Fundamentals of the following machine elements:			
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>			



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: Advance	d Mechanical 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  • Belt & chain drives  • Gear drives  • Gear drives  • Epicyclic gears
	<ul> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



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		



Courses					
Title		Тур	Hrs/wk	СР	
Computational Fluid Dynami	cs I (L0235)	Lecture	2	3	
Computational Fluid Dynami	cs I (L0419)	Recitation Section (large)	2	3	
Module Responsible	Prof. Thomas Rung				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematical Methods for Engined     Fundamentals of Differential/integ		s		
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learning	results		
Professional Competence					
Knowledge	The students are able to list the basic nun	nerics of partial differential equation	ons.		
Skills	The students are able develop appropriate numerical integration in space and time for the governing partial differential equations. They can code computational algorithms in a structured way.				
Personal Competence  Social Competence	The students can arrive at work results in groups and document them.				
Autonomy	The students can independently analyse approaches to solving specific problems.				
Workload in Hours	I Independent Study Time 124, Study Time	in Lecture 56			
Credit points					
Studienleistung					
	Written exam				
Examination duration and scale	2h				
Assignment for the Following Curricula	It-concret Engineering Science (English program): Specialisation Mechanical Engineering Fee				



Course L0235: Computa	tional 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: Computa	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			



Madula MOCOO. Oa	on and Ota and David	au Diamta			
Module M0639: Ga	is and Steam Pow	er Plants			
Courses					
Title	to (1,000C)		<b>Typ</b> Lecture	Hrs/wk	CP
Gas and Steam Power Plan Gas and Steam Power Plan			Recitation Section (larg	3 je) 2	4 2
Module Responsible	Prof. Alfons Kather				
Admission Requirements	i				
Recommended Previous Knowledge	■ "Hoat Tranctor"	-	d II"		
<b>Educational Objectives</b>	After taking part success	fully, students h	ave reached the following learn	ing results	
Professional					
Competence	The students can evaluroutes in the thermal p steam generator block.	ower plant, des They are also	pment of the electricity demands cribe the various types of powable to determine the operation	ver plant and to on characterist	the layout of the
Knowledge	possibilities of convent plants or plants equippe	ional fossil-fuel d with Carbon (	-	nermal and ge	othermal power
	The students have basic	knowledge abo	out the principles, operation and	l design of turb	omachinery
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels based on well-founded knowledge on the function and construction of gas and steam power plant identify basic associations in the production of heat and electricity, so as to develop concersolutions. Through analysis of the problem and exposure to the inherent interplay between heat power generation the students are endowed with the capability and methodology to develop real optimal concepts for the generation of electricity and the production of heat. From the technical baths students become the ability to follow better the deliberations on the electricity mix compose within the energy-political triangle (economy, secure supply and environmental protection).				power plants, to elop conceptua etween heat and develop realistic technical basics mix composition
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional <sup>TM</sup> . With this tool small practical tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.				
	The students are able single component or at s	•	calculations on turbomachine	ry either as pa	art of a plant, as
Personal Competence					
Social Competence	students get in this mar	iner direct conta	the lecture is planned for stu act with a modern power plant i ower plant in operation and o	n this region.	The students will
Autonomy	with these scenario and is consolidated and the highlighted. The studer	llyses. In this map potential effects its are able ind	be able to develop alone sime anner the theoretical and practical and practical from different process combined ependently to analyse the operantities and characteristic curves	cal knowledge ations and bou rational perfor	from the lecture
	Independent Study Time	e 110, Study Tim	e in Lecture 70		
Credit points	J				
	Compulsory Bonus	Form	<b>Description</b> 15-minütige		s Testat über



Studienleistung	g No 5 %		station	EBSILON Professional; nur bestanden/nicht bestanden (keine	
	No	5 % Exc	ercises	anteili <b>៉្វាទេ</b> ហក្សឹ <b>មដល់</b> ខ្លែaben im Laufe der Vorlesungen à 5 Minuten; bis zu 5 % Bonus je nach Anteil richtiger Abgaben	
Examination	Written exam				
Examination duration and scale	Written exami	nation of 120 min			
_	Engineering: General Engineeral : General Engineeral Engineering:	Compulsory ineering Science ms: Compulsory gineering Science Engineering: Con neering Science Systems: Electiv Invironmental Engineering Science Compulsory ineering Science ms: Compulsory neering Science Compulsory neering Science Systems: Electiv Systems: Electiv	ce (German program): Spece (German program, mpulsory German program, 7 seme e Compulsory gineering: Core qualification (English program): e (English program): Spece (English program, 7 seme (English program, 7 seme (English program, 7 seme	Specialisation Energy and Enviromental ecialisation Mechanical Engineering, Focus ster): Specialisation Energy and Enviromental ster): Specialisation Mechanical Engineering,	



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



-	Desitation Costion (large)
	Recitation Section (large)
Hrs/wk	
СР	<u>2</u>
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
	In the 1 <sup>st</sup> part of the lecture a general introduction into fluid-flow machines and steam power plant offered, including:  • Energy balance of a fluid-flow machine  • Theory of turbine and compressor stage
	<ul> <li>Equal and positive pressure blading</li> <li>Flow losses</li> <li>Characteristic numbers</li> <li>Axial and radial design</li> <li>Design features</li> <li>Hydraulic fluid-flow machines</li> <li>Pump and water turbine designs</li> </ul>
	<ul> <li>Pump and water turbine designs</li> <li>Design examples of reciprocating engines and turbomachinery</li> <li>Steam power plants</li> <li>Gas turbine systems</li> <li>Diesel engine systems</li> <li>Waste heat utilisation</li> </ul>
Content	<ul> <li>Electricity Demand and Forecasting</li> <li>Thermodynamic fundamentals</li> <li>Energy Conversion in Thermal Power Plants</li> <li>Types of Power Plant</li> <li>Layout of the power plant block</li> <li>Individual elements of the power plant</li> <li>Cooling systems</li> <li>Flue gas cleaning</li> <li>Operation characteristics of the power plant</li> <li>Construction materials</li> <li>Location of power plants</li> </ul> The environmental impact of acidification, fine particulate or CO <sub>2</sub> emissions and the resulting clim effects are a special focus of the lecture and the lecture hall exercise. The challenges in p operation from interconnecting conventional power plants and renewable energy sources discussed and the technical options for providing security of supply and network stability presented, also under consideration of cost effectiveness. In this critical review, focus is especial placed on the compatibility of the different solutions with the environment and climate. With this, awareness for the responsibility of an engineer's own actions are emphasized and the potential ex of the different solutions presented clearly.  Within the framework of the exercise the students learn the use of the specialised software is EBSILON Professional TM. With this tool small tasks are solved on the PC, to highlight aspects of design and development of power plant cycles. The students present their results orally and afterwards ask questions and get feedback. The course work has a positive effect on the students for a positive effect on the students for additional properties.
Literature	<ul> <li>Skripte</li> <li>Kalide: Kraft- und Arbeitsmaschinen</li> <li>Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985</li> <li>Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006</li> <li>Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990</li> <li>T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwe Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul>



Module M1022: Re	eciprocating Machinery			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Reciproca	ating Engines and Turbomachinery - Part Recip	procating Lecture	1	1
Engines (L0634)	ating Engines and Turbomachinery - Part Recip		1	1
Internal Combustion Engines Internal Combustion Engines		Lecture Recitation Section (large)	2 1	2 2
Module Responsible	Prof. Christopher Friedrich Wirz			
Admission Requirements	·			
Recommended Previous Knowledge	Thermodynamics, Mechanics, Machine Ele	ments		
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence	As a result of the part module "Fundamen	tale of Decimenation Mark'	انتدم مطاح الاس	anto eva =l=1:
Knowledge	reflect fundamentals regarding power and working machinery and describe the qualitative quantitative correlations of operating methods and efficiencies of multiple types of engi compressors and pumps. They are able to utilize technical terms and parameters as well as asp regarding the development of power density and efficiency, furthermore to give an overview charging systems, fuels and emissions. The students are able to select specific types of machinery assess design related and operational problems.			es of engine well as aspe- an overview f machinery a
	As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design.			
Skills	The students are skilled to employ basic and detail knowledge regarding reciprocating machine their selection and operation. They are further able to assess, analyse and solve technical a operational problems and to perform mechanical and thermodynamic design.			
Personal Competence	! !			
Social Competence	The students are able to communicate and cooperate in a professional environment in the field of machinery design and application.			
Autonomy	The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently.			
Workload in Hours	I Independent Study Time 110, Study Time in	n Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the	General Engineering Science (German penergy Systems: Compulsory General Engineering Science (German pro Focus Energy Systems: Compulsory General Engineering Science (English penergy)	gram, 7 semester): Specialisatio	on Mechanio	cal Engineerir

Following Curricula



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

Course L0633: Fundamentals 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		
Content	Verbrennungsmotoren  Historischer Rückblick  Einteilung der Verbrennungsmotoren  Arbeitsverfahren  Vergleichsprozesse  Arbeit, Mitteldrücke, Leistungen  Arbeitsprozess des wirklichen Motors  Wirkungsgrade  Gemischbildung und Verbrennung  Motorkennfeld und Betriebskennlinien  Abgasentgiftung  Gaswechsel  Aufladung  Kühl- und Schmiersystem  Kräfte im Triebwerk  Kolbenverdichter  Thermodynamik des Kolbenverdichters  Einteilung und Verwendung  Kolbenpumpen  Prinzip der Kolbenpumpen  Einteilung und Verwendung	
Literature	<ul> <li>A. Urlaub: Verbrennungsmotoren</li> <li>W. Kalide: Kraft- und Arbeitsmaschinen</li> </ul>	

Course 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 (	Combustion 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	<ul> <li>The beginnings of engine development</li> <li>Design of of motors</li> <li>Real process calculation</li> <li>Charging methods</li> <li>Kinematics of the crank mechanism</li> <li>Forces in the engine</li> </ul>
Literature	<ul> <li>Vorlesungsskript</li> <li>Übungsaufgaben mit Lösungsweg</li> <li>Literaturliste</li> </ul>

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 M0829: Fo	oundations of Management			
	andiagomont			
Courses			11	
Title  Management Tutorial (L088)  Introduction to Management		r <b>p</b> ecitation Section (large) cture	Hrs/wk 2 3	<b>CP</b> 3 3
	·	otal o		
Module Responsible  Admission				
Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
<del>-</del>	After taking part successfully, students have reached t	the following learning r	esults	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> </ul>			
Personal Competence				
Social Competence	Students are able to  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherence.			
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 7	70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# Assignment for the Following Curricula

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

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

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

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

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

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



Compulsor	Co	mpu	llsor
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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 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 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: Managen	nent Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
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 self-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.



rse L0880: Introduct	ion 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. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: Re	enewables and Energy Systems			
Courses				
Title Power Industry (L0316) Energy Systems and Energy	y Industry (L0315)	Typ Lecture Lecture	Hrs/wk 1 2 2	<b>CP</b> 1 2
Renewable Energy (L0313) Renewable Energy (L1434)		Lecture Recitation Section (small)	1	2 1
	Prof. Martin Kaltschmitt	· · · · · · · · · · · · · · · · · · ·	·	·
Admission Requirements				
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning i	results	
Professional Competence				
Knowledge	With completion of this module, the students can provide an overview of characteristics of energy systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them. Furthermore, the students can explain the environmental benefits from the use of such systems.			
Skills	Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design them under certain given conditions. Therefore, they can choose the necessary subject-specific 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.			
		C		
Personal Competence  Social Competence	The students are able to analyze suitable techn economical and ecological criteria under sustaina contribuition to a more sustainable power supply.			
Autonomy	Students can independently exploit sources , acq and transform it to new questions.	uire the particular knowled	dge about th	e subject area
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	13 noure written eyam			
Assignment for the Following Curricula	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Enviromental Engineering: Compulsory General Engineering Science (German program, Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core qua General Engineering Science (English prog Engineering: Compulsory	gram, 7 semester): Sp 7 semester): Specialisation	ecialisation n Mechanica	Energy and



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

Course L0316: Power Inc	dustry
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
Content	<ul> <li>Electrical energy in the energy system</li> <li>Demand and use of electrical energy (households, industry, "new" buyers (including emobility))</li> <li>Electricity generation         <ul> <li>electricity generation technologies using fossil fuels and their characteristics</li> <li>combined heat and power technologies and their production characteristics</li> <li>electricity generation from renewable energy technologies and their characteristics</li> </ul> </li> <li>Power distribution         <ul> <li>"classic" distribution of electrical energy</li> <li>challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading)</li> </ul> </li> <li>District heating industry</li> <li>Legal and administrative aspects         <ul> <li>Energy Act</li> <li>support instruments for renewable energy</li> <li>CHP Act</li> </ul> </li> <li>Cost and efficiency calculation</li> </ul>
Literature	Folien der Vorlesung

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



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

Course L1434: Renewable Energy		
Тур	Recitation Section (small)	
Hrs/wk	1	
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	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>	



#### **Focus Aircraft Systems Engineering**

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

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

Module M0597: Ad	Ivanced Mechanical Enginee	ring Design		
Courses				
Title	ing Design II (I 0004)	Тур	Hrs/wk	CP
Advanced Mechanical Engir Advanced Mechanical Engir		Lecture Recitation Section (large)	2	2 1
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students h	nave reached the following learning	results	
Professional				
Competence	After passing the module, students are a			
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic element of fluidics</li> </ul>			
Skills	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically.			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time	e in Lecture 112		
Credit points	6			
Studienleistung	None			
	<u> </u>			



Examination	Written exam
Examination duration and scale	120
and scale	Occupies in the Color of Color
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in 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 Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	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
	H OCUS ENETUV SYSTEMS, COMBUNSOM
	Mechanical Engineering: Core qualification: Compulsory



Course L0264: Advance	d Mechanical 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  • 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  • Belt & chain drives  • Gear drives  • Gear drives  • Sliding bearings  • Crank gears  • Sliding bearings
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



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	



ourse L0262: Advance	d Mechanical 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
	Advanced Mechanical Engineering Design I & II
Content	Fundamentals of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



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	



gnals and Systems			
	Тур	Hrs/wk	СР
2)	Lecture	3	4
3)	Recitation Section (small)	2	2
Prof. Gerhard Bauch			
None			
Mathematics 1-3			
covered by the moduls Mathematik 1-3 is e	xpected. Further experience w	ith spectral	-
After taking part successfully, students have	reached the following learning	results	
methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both	y are able to apply the fund nd systems. They can describe time and image domain. In par	amental tra e and analy ticular, they	nsformations o se deterministio understand the
using methods of signal and system theory important properties such as magnitude and	. They can analyse and design phase response, stability, line	n basic sys earity etc T	tems regarding
The students can jointly solve specific proble	ems.		
control their level of knowledge during the I			-
	Lecture 70		
<del></del>			
90 min			
General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	ram): Specialisation Computer ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation ram): Specialisation Biomedica gram, 7 semester): Specialisation ogram, 7 semester): Specialisation ram, 7 semester): Specialisation spram, 7 semester): Specialisation ram, 7 semester): Specialisation spram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation spram, 7 semester): Specialisation ram, 7 semester): Specia	Science: Congineering: Sengineering: Sengineering: Sengineering Mechanical Engineering Electrical Electrical Engineering Electrical Engineering Electrical Engineering Electrical Engineering Electrical Electrical Engineering Electrical Electri	ompulsory Compulsory ng: Compulsory Enviromenta I Engineering ng: Compulsor al Engineering nputer Science as Engineering ss Engineering
	Prof. Gerhard Bauch  None  Mathematics 1-3  The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is et (Fourier series, Fourier transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional transform, Laplace traditional traditional transform, Laplace traditional	Prof. Gerhard Bauch  None  Mathematics 1-3  The modul is an introduction to the theory of signals and systems. Goc covered by the moduls Mathematik 1-3 is expected. Further experience w (Fourier series, Fourier transform, Laplace transform) is useful but not required. After taking part successfully, students have reached the following learning.  The students are able to classify and describe signals and linear time-inmethods of signal and system theory. They are able to apply the fundinguing and systems mathematically in both time and image domain. In par effects in time domain and image domain which are caused by the transignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-inmethods of signal and systems mathematically in both time and image domain. In par effects in time domain and image domain which are caused by the transignal to a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-inmethods of signal and system theory. They can analyse and designimportant properties such as magnitude and phase response, stability, line the impact of LTI systems on the signal properties in time and frequency down the inventor of their level of knowledge during the lecture period by solving tutoric clicker system.  Independent Study Time 110, Study Time in Lecture 70  6  None  Written exam  90 min  General Engineering Science (German program): Specialisation Electrical Ceneral Engineering Science (German program): Specialisation Bioproces General Engineering Science (German program, 7 semester): Specialisation Compulsory  General Engineering Science (German program, 7 semester): Specialisation Compulsory  General Engineering S	Typ Hrs/wk Lecture 3 Recitation Section (small) 2  Prof. Gerhard Bauch  None  Mathematics 1-3  The modul is an introduction to the theory of signals and systems. Good knowled: covered by the moduls Mathematik 1-3 is expected. Further experience with spectral (Fourier series, Fourier transform, Laplace transform) is useful but not required.  After taking part successfully, students have reached the following learning results  The students are able to classify and describe signals and linear time-invariant (LTI methods of signal and system theory. They are able to apply the fundamental tra continuous-time and discrete-time signals and systems. They can describe and analy signals and systems mathematically in both time and image domain. In particular, they effects in time domain and image domain which are caused by the transition of a discrete-time signal.  The students are able to describe and analyse deterministic signals and linear time-in using methods of signal and system theory. They can analyse and design basic system properties such as magnitude and phase response, stability, linearity etc The important properties such as magnitude and phase response, stability, linearity etc The students can jointly solve specific problems.  The students can jointly solve specific problems.  The students are able to acquire relevant information from appropriate literature sociontrol their level of knowledge during the lecture period by solving tutorial problems clicker system.  Independent Study Time 110, Study Time in Lecture 70  6  None  Written exam  90 min  General Engineering Science (German program): Specialisation Electrical Engineering General Engineering Science (German program): Specialisation Bioprocess Engineering General Engineering Science (German program): Specialisation Bioproces Engineering General Engineering Science (German program): Specialisation Biomedical Engineering Ceneral Engineering Science (German program, 7 semester): Specialisation Electric Compulsory  General Engineering Science (German



Focus Biomechanics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

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

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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				
<b>Title</b> Advanced Mechanical Desi	gn Project (L0266)	<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Dr. Jens Schmidt	<u> </u>		
Admission Requirements				
Recommended Previous Knowledge	3 - 3	Design		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence		to:		
Knowledge	<ul> <li>express the procedure for systematic</li> <li>complex design tasks ,</li> <li>describe working principles, their use</li> <li>explain guidelines for designing for f</li> <li>explain advanced use-oriented known</li> </ul>	e and combination possibilities unction and manufacturing,	·,	
Skills	After passing the module, students are able  analyze complex tasks and develop  convert principle solutions into a deta  use methods to design and solve oriented,  create a technical documentation inconstitutions of the system,  document calculations of selected methods.	orinciple solutions using sketch alled design, engineering design tasks s cluding all necessary technical	ystematicall	
Personal Competence				
Social Competence	After passing the module, students are able     present and discuss solutions and te     reflect the own results in the work groups.	chnical drawings within groups	S,	
Autonomy	After passing the module, students are able     independently solve complex decomples and selecting     to independently solve problems.	sign projects, while motivat	ing themse	lves, acquirin
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Studienleistung	Compulsory BonusFormYesNoneAttestation	Description		
Examination	Written exam			
Examination duration and scale	180  General Engineering Science (German n	ragram): Chanialiastics Mark	unnical En-	nooring Fa
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory			



## Assignment for the Following Curricula

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

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

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

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Course L0266: Advanced Mechanical Design Project				
Typ 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			
	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.			
Content	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	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>			



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Courses					
Title Simulation and Design of Mechatronic Systems (L1822)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2	
	echatronic Systems (L1823)	Recitation Section (large)	1	2	
Simulation and Design of Me	echatronic Systems (L1824)	Practical Course	1	2	
Module Responsible	Prof. Uwe Weltin				
Admission Requirements	None				
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory	and electrical engineering			
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional Competence					
Knowledge	Students are able to describe methods optimization of mechatronic systems.	and calculations for design,	modeling,	simulation an	
Skills	Students are able to apply modern algorith simulate and design simple systems and in			ney can identify	
Personal Competence					
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.			rget groups.	
	Students are able to recognize and improve knowledge deficits independently.				
Autonomy	With instructor assistance, students are able to evaluate their own knowledge level and define further course of study.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Studienleistung	<u> </u>				
	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Mechatronical Engineering: Compulsory General Engineering Science (German Mechanical Engineering: Compulsory General Engineering Science (German Profocus Mechatronics: Compulsory General Engineering Science (German Profocus Aircraft Systems Engineering: Compulsory General Engineering Science (German Profocus Theoretical Mechanical Engineering General Engineering Science (English Mechatronics: Compulsory General Engineering Science (English Mechatronics: Compulsory General Engineering Science (English Mechatronics: Compulsory General Engineering Science (English Profocus Mechatronics: Compulsory General Engineering Science (English Profocus Aircraft Systems Engineering: Compulsory General Engineering Science (English Profocus Aircraft Systems Engineering: Compulsory General Engineering Science (English Profocus Aircraft Systems Engineering: Compulsory General Engineering Science (English Profocus Theoretical Mechanical Engineering Mechanical Engineering: Specialisation Air	program): Specialisation Mechanisms (Specialisation Mechanisms): Specialisation Mechanisms, 7 semester): Specialisation (Specialisation): Specialisation (Specialisat	anical Enginanical	neering, Focu neering, Focu cal Engineering cal Engineering cal Engineering neering, Focu neering, Focu neering, Focu cal Engineering	



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechatronics: Core qualification: Compulsory

Course L1822: Simulation	ourse L1822: Simulation and Design of Mechatronic Systems			
Тур	ecture			
Hrs/wk				
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	ourse 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	ourse 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		



Courses						
litle			Тур	Hrs/wl	k	СР
Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)			Lecture Recitation Section (sn	2 nall) 2		4 2
Module Responsible	Prof. Herbert Wer	ner				
Admission Requirements	None					
Recommended Previous Knowledge	Representation o	f signals and systems i	n time and frequency domain,	Laplace trans	sform	
Educational Objectives	After taking part s	uccessfully, students h	ave reached the following lear	ning results		
Professional Competence						
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequenc response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>					
Skills	vice versa  They can s  They can s  They can frequency  They can and use it	simulate and assess the design PID controllers analyze and synthe response techniques calculate discrete-tim for digital implementate	of linear dynamic systems from the behavior of systems and con with the help of heuristic (Ziegl size simple control loops wi the approximations of controlle tools (Matlab Control Toolbox)	trol loops er-Nichols) to th the help rs designed	uning roof	rules ot locus ar ntinuous-tim
Personal Competence						
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs					
Autonomy	Students can ob experiment guide	tain information from s) and use it when solv	provided sources (lecture r ving given problems. ekly on-line tests and thereby o			
Workload in Houre	Independent Stud	ly Time 124, Study Tim	e in Lecture 56			
Credit points		y Timo 124, Oludy Till	io in Ecoluic 30			
Studienleistung						
_	Written exam					
Examination duration and scale						



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	
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 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	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	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		



Courses Title			Typ	Hrs/wk	СР
True Computer Engineering (L032	21)		<b>Typ</b> Lecture	3	4
Computer Engineering (L032	24)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge	marks due to the	etion of the labs will be the following rules: module examination, the successful labs, such	e honored during the ne student is granted a that the examination's m	bonus on the	e examination'
	respectively, up to the next-better grade.  2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible.				
Educational Objectives	After taking part success	fully, students have reac	hed the following learnin	g results	
Professional Competence					
Knowledge	<ul> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal contents of the computer systems from the architect's perspective, i.e., they identify the internal contents of the computer systems from the architect's perspective, i.e., they identify the internal contents of the contents				
Skills	structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of today 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 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 Lect	ure 56		
Credit points	ļ				
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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: 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: Compute	er Engineering		
Тур	Lecture		
Hrs/wk	3		
СР			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Compute	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		



Courses					
Title			Тур	Hrs/wk	СР
CAE-Team Project (L0271)			Project-/problem-b Learning	pased 2	2
Development of Lightweight ntegrated Product Develop			Lecture Lecture	2 2	2
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
	Advanced Knowledge at	out engineering des	ign:		
	Fundamentals of Mechar	nical Engineering De	sign		
Recommended	Mechanical Engineering		- 3		
Frevious Knowleage		_			
	Advanced Mechanical E	ngineering Design			
Educational Objectives	After taking part successi	fully, students have re	eached the following l	earning results	
Professional					
Competence					
	After completing the module, students are capable of:				
Knowledge	<ul> <li>explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems</li> <li>describing the interaction of the different CAE-Systems in the product development proces</li> </ul>				
	After completing the mod	ule, students are abl	e to:		
Skills	<ul> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such a classification schemes and product structuring</li> <li>design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload</li> </ul>				
Personal Competence					
	After completing the mod	ule, students are abl	e to:		
Social Competence	group discussion	S	e work appropriate w stance in a presentati		the framework
	Students are capable of:				
Autonomy	·	apt to a CAE-Tool ar	d complete a given pr	actical task with it	
Workload in Hours	Independent Study Time	96, Study Time in Le	cture 84		
Credit points	· · · · · · · · · · · · · · · · · · ·	· •			
•	Compulsory Bonus	Form	Descrip	tion	
Studienleistung	Yes 20 %	Subject theore practical work	•	amprojekt inkl.	Vortrag ur
Examination	Written exam				
Examination duration and scale	90				
	General Engineering Son Aircraft Systems Engineer General Engineering Son Product Development an	ring: Compulsory cience (German pro	gram): Specialisation		



	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory
	Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory

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



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

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



Module M0767: Ae	ronautical Systems			
Courses				
Title Fundamentals of Aircraft Sy Fundamentals of Aircraft Sy Air Transportation Systems Air Transportation Systems	stems (L0742) (L0591)	Typ Lecture Recitation Section (small) Lecture Recitation Section (large)	Hrs/wk 2 1 2	<b>CP</b> 2 1 2 1
	Prof. Frank Thielecke			
Admission Requirements				
Recommended Previous Knowledge	Basics of mathematics, mechanics and thermod	dynamics		
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
	Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.			
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system.			
Personal Competence				
Social Competence	Students are made aware of interdisciplinary co	ommunication in groups.		
Autonomy		Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented.		
Workload in Hours	Independent Study Time 96, Study Time in Lect	ture 84		
Credit points	6			
Studienleistung				
	Written exam			
Examination duration and scale	150 min			
_	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory Logistics and Mobility: Specialisation Logistics and Mobility: Elective Compulsory			

Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory



Course L0741: Fundamentals 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	<ul> <li>Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials</li> <li>Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems</li> </ul>	
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	<ol> <li>Air transport as part of the global transportation system</li> <li>Legal basis of air transportation</li> <li>Safety and security aspects</li> <li>Aircraft basics</li> <li>The role of the aircraft amnufacturer</li> <li>The role of the aircraft operator</li> <li>Airport operation</li> <li>The principles of air traffic management</li> <li>Environmental aspects of air transportation</li> <li>Future perspectives of air transport</li> </ol>	
Literature	<ol> <li>V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5</li> <li>H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003</li> <li>K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0</li> <li>I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5</li> <li>D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3</li> <li>N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4</li> <li>P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8</li> <li>H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0</li> </ol>	

Course L0816: Air Transportation Systems		
	Recitation Section (large)	
Hrs/wk		
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	



Module M0829: Fo	undations of Management			
	anono or managomont			
Courses		T	Hue had	OD.
Title Management Tutorial (L088)	2)	<b>Typ</b> Recitation Section (large)	Hrs/wk 2	<b>CP</b> 3
Introduction to Management	(L0880)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge				
	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry 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 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  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherent			
Autonomy	work in a team and to organize the team     to write a report on their project.	themselves		
	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



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



ourse L0880: Introduct	ion 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	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>	
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: Ad	Ivanced Mechanical Engin	eering Design		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engir	, ,	Lecture	2	2
Advanced Mechanical Engir Advanced Mechanical Engir		Recitation Section (large) Lecture	2 2	1 2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanica</li> <li>Mechanics</li> <li>Fundamentals of Materials S</li> <li>Production Engineering</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, studer	nts have reached the following learning	results	
Professional				
Competence	After passing the module, students a			
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically.			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study 7	Time in Lecture 112		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration	120			



### and scale

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus 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	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II
Content	• Fundamentals of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Seals  • Clutches & brakes  • Belt & chain 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  • Belt & chain drives  • Gear drives  • Gear drives  • Crank gears  • Crank gears  • Sliding bearings
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage.</li> </ul>



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



ourse L0262: Advance	d Mechanical 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
	Advanced Mechanical Engineering Design I & II
Content	Fundamentals of the following machine elements:
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



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



H		Hrs/wk	CP
3 II) 2	re ation Section (small)		4 2
with	and systems. Go orther experience v useful but not requ	ith spectral	
ng res	e following learning	results	
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. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.			
sign b Iineari	nistic signals and I analyse and desi ponse, stability, lin e and frequency do	gn basic sys earity etc T	tems regarding
The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system.		•	
ter Sci s Engil cess En n Civ n Me dical En disation disation disation Englished	ialisation Electrical ialisation Compute ialisation Process Is ialisation Bioproces: Specialisation: Specialisation: Specialisation Biomedic mester): Specialisation Biomedic mester mest	Science: Co Engineering: Ss Engineerin Civil- and Mechanical al Engineerin tion Electric isation Com ation Proces on Bioproces	ompulsory Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering puter Science as Engineering ss Engineering
100	ostor). Opecial	Ioun	lisation Mechanic



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 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

Assignment for the

**Following Curricula** 

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

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

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

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

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

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

Compulsory

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

Compulsory

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

Compulsory

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

Compulsory

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

Compulsory

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

Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

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



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: Str	ructural Materials			
module mosco. Ot	dotarai materiais			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanica	al Properties of Materials (L1090)	Lecture	2	3
Welding Technology (L1123	)	Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous Knowledge	l Filindamontale of Materiale Science			
<b>Educational Objectives</b>	After taking part successfully, students	have reached the following lea	rning results	
Professional				
Competence				
Knowledge	The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowlegde in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynamic loads. The students get to know the most important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design.			
Skills	The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials.  The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks.			
Personal Competence				
Social Competence				
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Ti	me in Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (Germ Materials in Engineering Sciences: Co General Engineering Science (German Focus Materials in Engineering Science (Engl Materials in Engineering Sciences: Co General Engineering Science (English Focus Materials in Engineering Science (English Focus Materials in Engineering Science Mechanical Engineering: Specialisation	impulsory in program, 7 semester): Special ces: Compulsory ish program): Specialisation impulsory in program, 7 semester): Special ces: Compulsory	alisation Mechanic Mechanical Engi Ilisation Mechanic	cal Engineering, neering, Focus



Course L1090: Fundame	entals of Mechanical Properties of Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Norbert Huber, Dr. Erica Lilleodden
Language	EN
Cycle	SoSe
Content	<ol> <li>Introduction and overview</li> <li>Bonding and crystallography, stress, strain, linear elasticity</li> <li>Plasticity of metallic materials</li> <li>Dislocations: Structure, stress, strain, strain energy</li> <li>Dislocations: Motion and forces</li> <li>Partial dislocations, dislocation interactions, jogs and kinks</li> <li>Strengthening mechanisms</li> <li>Introduction to modelling of materials behaviour, classification of</li> <li>phenomena</li> <li>Linear and nonlinear elasticity</li> <li>Plasticity, tensile loading, cyclic loading</li> <li>Viscoelasticity, effects of loading history, creep, relaxation</li> <li>Viscoplasticity, overstress, rate sensitivity of metallic materials</li> <li>Identification of material parameters</li> </ol>
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	WiSe
	- 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
Content	- 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
	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.
Literature	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.



Courses					
Title		Тур	Hrs/wk	СР	
Numerical Mathematics I (LI Numerical Mathematics I (LI	•	Lecture Recitation Section (small)	2	3 3	
•	Prof. Sabine Le Borne	Trochation Cooker (emaily	_		
Admission					
Requirements	None				
Recommended Previous Knowledge	I II for Technomathematicians				
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional Competence					
	Students are able to				
Knowledge	<ul> <li>name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computations and storage complexitx.</li> </ul>				
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 an solution algorithm,  select and execute a suitable solution approach for a given problem.				
Personal Competence					
	Students are able to				
Social Competence	<ul> <li>work together in heterogeneously composed teams (i.e., teams from different study programmed and background knowledge), explain theoretical foundations and support each other was practical aspects regarding the implementation of algorithms.</li> </ul>				
	Students are capable				
Autonomy	to assess whether the supporting theoretical and practical excercises are better solve.				
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points					
Studienleistung					
Examination	Written exam				
Examination duration and scale	90 minutes				
	General Engineering Science (German prog General Engineering Science (German p Biomechanics: Compulsory General Engineering Science (German p Materials in Engineering Sciences: Compuls General Engineering Science (German prog General Engineering Science (German p Compulsory	rogram): Specialisation Mech rogram): Specialisation Mech sory (ram): Specialisation Biomedica	anical Engi anical Engi al Engineeri	neering, Focu neering, Focu ng: Compulsor	



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 Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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
Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

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



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



Module M1009: Ma	nterial Science Laboratory				
Courses					
Title		Тур	Hrs/wk	СР	
Companion Lecture for Materials Science Laboratory (L1088)		Lecture	2	2	
Material Science Laboratory	(L1235)	Practical Course	4	4	
Module Responsible	Prof. Bodo Fiedler				
Admission Requirements	None				
Recommended Previous Knowledge	none				
<b>Educational Objectives</b>	After taking part successfully, students have re	ached the following lear	rning results		
Professional					
Competence					
Knowledge	Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.				
Skills	The students can transfer their fundamental knowledge on material sciences to the process of solving practical problems. They identify and overcome typical problems during the realization of experiments in the context of material sciences.				
Personal Competence					
Social Competence	Students are able to cooperate in small groups in order to conduct experiments in the context of				
Autonomy	Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor.				
Workload in Hours	Independent Study Time 96, Study Time in Led	cture 84			
Credit points	6				
Studienleistung	None				
Examination	Written exam				
Examination duration and scale	1,5 h written Exam (50%) covering the lesson				
_	General Engineering Science (German prog Materials in Engineering Sciences: Compulsor General Engineering Science (German prog Product Development and Production: Compu General Engineering Science (German progra Focus Materials in Engineering Sciences: Com General Engineering Science (English prog Materials in Engineering Sciences: Compulsor General Engineering Science (English prog Product Development and Production: Compu General Engineering Science (English progra Focus Materials in Engineering Sciences: Com Mechanical Engineering: Specialisation Product Mechanical Engineering: Specialisation Mater Product Development, Materials and Product Elective Compulsory	gram): Specialisation Malsory Isory Im, 7 semester): Special Inpulsory Igram): Specialisation Malsory Isory Im, 7 semester): Special Inpulsory Inpulsory Into Development and Proial Isonialis in Engineering Scie	Mechanical Engineration Mechanical Enginechanical E	neering, Focus cal Engineering, neering, Focus neering, Focus cal Engineering, lsory	



Course L1088: Companion Lecture 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	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		



courses				
Title		Тур	Hrs/wk	СР
ntroduction to Control Syste	, ,	Lecture	2	4
ntroduction to Control Syste	ms (L0655)	Recitation Section (sma	all) 2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals an	systems in time and frequency domain, L	aplace transfor	m
Educational Objectives	After taking part successfully	students have reached the following learn	ing results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small their controller designs	groups to jointly solve technical problem	s, and experin	nentally valida
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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		
Credit points		Cady Timo in Lociate 50		
Studienleistung				
Examination				
Examination duration and scale				



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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	/iSe		
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 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		
Literature	<ul> <li>Computer-based exercises throughout the course</li> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



Course L0655: Introduct	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	



		ing			
Courses					
<b>Title</b> Computer Engineering (L03: Computer Engineering (L03:			Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
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:  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 of 4,3 up to 4,0 is not possible.				
<b>Educational Objectives</b>	After taking part succes	sfully, students have re	ached the following learning	results	
Professional Competence					
Knowledge	<ul> <li>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:         <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses</li> </ul> </li> </ul>				
Skills	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 computer 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 sol	lve similar problems ald	one or in a group and to pres	ent the resu	Its 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	e 124, Study Time in Le	ecture 56		
Credit points	6				
Studienleistung	Compulsory Bonus Yes 10 %	Form Excercises	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering:  Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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
Accianment for the	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
	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: Compute	r 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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: En	hanced Fundamentals of Materia	ls Science		
Courses				
	eramics and Polymers (L1233) eramics and Polymers (L1234) letals (L1086)	Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	<b>CP</b> 2 1 3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements				
Recommended Previous Knowledge	Module "Fundamentals of Materials Science"  Module "Materials Science Laboratory"  Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, electrical and mass transport, microstructure and phase diagrams. They are capable to explain the corresponding technical terms.			
Skills  Personal Competence  Social Competence  Autonomy	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge.			
Workload in Hours	   Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
Studienleistung				
Examination	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German program): 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 Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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 Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Typ Hrs/wk CP	Lecture
СР	]2
	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
	1. Einführung
	Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik Sprühtrockner
	3. Formgebung
	Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte)
Content	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
	Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Application 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



Literature

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. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1086: Enhanced Fundamentals: Metals		
Тур	Lecture	
Hrs/wk	2	
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: applications	
Literature	Vorlesungsskript	



Module M0829: Fo	undations of Management			
	and-individual individual ind			
Courses		<b>T</b>	II. C.	O.D.
Title  Management Tutorial (L088) Introduction to Management		<b>Typ</b> Recitation Section (large) Lecture	<b>Hrs/wk</b> 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	describe and explain basic business supply chain management, organization management are explain the relevance of planning and multiple objectives and uncertainty, at Finance     state basics from accounting and costing	to Marketing and Innovation to Marketing and Management at initions from the field of Marketing and poals in Management are functions as production, pon and human ressource and marketing decision making in Busines and explain some basic magand selected controlling marketing	and the sub nagement nd name the procurement management ss, esp. in s ethods from	o to Investment o-disciplines in most important and sourcing ent, information ituations under ituations under
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry 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 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  work successfully in a team of students  to apply their knowledge from the lectur report on the project  to communicate appropriately and  to cooperate respectfully with their fellow		roject and w	rite a coherer
Autonomy	Students are able to  work in a team and to organize the team to write a report on their project.	themselves		
Workload in Hours	Independent Study Time 110, Study Time in Lec	cture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek	
Language	DE	
Cycle	WiSe/SoSe	
	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 self-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.	



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

Courses						
Title		-1 II (I 000 t)		Тур	Hrs/wk	CP
Advanced Mechanical Engir Advanced Mechanical Engir	-	- , ,		Lecture Recitation Section (large)	2	2 1
Advanced Mechanical Engir	_			Lecture	2	2
Advanced Mechanical Engir	neering De	sign I (L0263)		Recitation Section (large)	2	1
Module Responsible	Prof. Die	eter Krause				
Admission Requirements	INone					
Recommended Previous Knowledge	• N	Fundamentals of Mechanic Mechanics Fundamentals of Materials Production Engineering		Design		
Educational Objectives	After tak	ing part successfully, stude	ents have reache	ed the following learning	results	
Professional						
Competence	i	ssing the module, students				
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples o complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>					
Skills	• a • tı • r	ssing the module, students accomplish dimensioning cransfer knowledge learned kills), ecognize the content of tectoral uate complex designs,	alculations of co d in the module hnical drawings	e to new requirements a	and tasks (p	problem solvir
Personal Competence	 					
Social Competence	• 8	Students are able to disc nethods.	uss technical in	nformation in the lectu	re supporte	d by activatin
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>					
Workload in Hours	Indepen	dent Study Time 68, Study	Time in Lecture	112		
Credit points	6					
Studienleistung	None					
Examination	Written e	exam				
Examination duration and scale						



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

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

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

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

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

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

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

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

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

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

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

# Assignment for the Following Curricula

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

Energy Systems: Compulsory

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

Aircraft Systems Engineering: Compulsory

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

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

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

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



Hrs/wk	Lecture
CD	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II
Content	• 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  • Gear drives  • Crank gears  • Crank gears  • Crank gears  • Sliding bearings
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>



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: Advance	d Mechanical 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  • Gear drives  • Epicyclic gears  • Crank gears		
	<ul> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Course 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



Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L043)		Lecture	3	4
Signals and Systems (L043:		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace transform)	xpected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and described methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal.	y are able to apply the fundand nd systems. They can describe time and image domain. In par	amental tra e and analy ticular, they	nsformations on se deterministi understand th
Skills	The students are able to describe and analy using methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal properties.	They can analyse and design hase response, stability, line	n basic sys earity etc T	tems regardin
Personal Competence				
Social Competence	The students can jointly solve specific proble			
Autonomy	The students are able to acquire relevant i control their level of knowledge during the l clicker system.			-
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory	ram): Specialisation Computer ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation Biomedica gram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semester): Spe	Science: Congineering: s Engineering: s Engineering: Civil- and Mechanica al Engineering tion Electrical sation Contation Procession	ompulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science



Focus Biomechanics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

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

Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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		
Typ Lecture		
Hrs/wk	3	
CP		
	Independent Study Time 78, Study Time in Lecture 42  Prof. Gerhard Bauch	
Language		
Cycle		
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations:         <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> </ul>	
	Fundamentals of recursive and non-recursive discrete-time filters	
I ito wo to wo	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> </ul>	
Literature	<ul> <li>J.R. Ohm, H.D. Lüke, Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>	



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



Courses				
Γitle	ту	/p	Hrs/wk	СР
Circuit Theory (L0566) Circuit Theory (L0567)		ecture ecitation Section (small)	3 2	4 2
Module Responsible	Prof. Arne Jacob			
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and 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 linear networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.			
	The students are able to calculate currents and voltages in linear networks by means of basi methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. The are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.			
Personal Competence  Social Competence	Students work on exercise tasks in small guided groutheir results within the group.	ups. They are encoura(	ged to prese	ent and discu
Autonomy	The students are able to find out the required methods for solving the given practice problem Possibilities are given to test their knowledge during the lectures continuously by means of short-tim tests. This allows them to control independently their educational objectives. They can link their gaine knowledge to other courses like Electrical Engineering I and Mathematics I.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70		
Credit points	6			
Studienleistung				
Examination				
Examination duration and scale	150 min			
Assignment for the	General Engineering Science (German program): Sp. General Engineering Science (German program): Mechatronics: Compulsory General Engineering Science (German program, 7 se Focus Mechatronics: Compulsory General Engineering Science (German program, 7 Compulsory Electrical Engineering: Core qualification: Compulsor General Engineering Science (English program): Spe General Engineering Science (English program):	Specialisation Mechanemester): Specialisation semester): Specialisation ry ecialisation Electrical E	n Mechanic ion Electric	neering, Foc al Engineerir al Engineerir Compulsory



Focus Mechatronics: 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 TI	heory
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
	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
Content	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
	- 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)
Literature	<ul> <li>- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)</li> <li>- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)</li> </ul>
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

Course L0567: Circuit Ti	heory
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
	siehe korrespondierende Lehrveranstaltung
Literature	see interlocking course



Module M1320: Sir	mulation and Design of Mechatro	nic Systems		
Courses				
Title Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	echatronic Systems (L1823)	Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory	and electrical engineering		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence	Students are able to describe methods a	and calculations for design	modeling	simulation and
Knowledge	optimization of mechatronic systems.			
Skills	Students are able to apply modern algorithm simulate and design simple systems and imp	=	-	ney can identify
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.			
Autonomy	Students are able to recognize and improve knowledge deficits independently.  With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German promechatronics: Compulsory General Engineering Science (German promerated Engineering Science (German promerated Mechanical Engineering: Compulsory General Engineering Science (German promechated Mechanical Engineering: Compulsory General Engineering Science (German promechated Engineering Science (German promechated Engineering: Compulsory General Engineering Science (German promechated Engineering: Compulsory General Engineering Science (German promechated Engineering: Compulsory General Engineering Science (English promechated Engineering: Compulsory General Engineering Science (English promechated Mechanical Engineering: Compulsory General Engineering Science (English promechated Mechanical Engineering: Compulsory General Engineering Science (English promechated Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory General Engineering Science (English progressed Engineering: Compulsory	ogram): Specialisation Mechalsory ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation	anical Enginanical Enginon Mechanical Enginanical Engi	neering, Focu neering, Focu cal Engineering cal Engineering cal Engineering neering, Focu neering, Focu neering, Focu cal Engineering



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechatronics: Core qualification: Compulsory

Course L1822: Simulation	on 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	urse 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	



Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L032 Computer Engineering (L032	•		Lecture Recitation Section (small	3	4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
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:  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 of 4,3 up to 4,0 is not possible.				
<b>Educational Objectives</b>	After taking part success	sfully, students have r	eached the following learning	g results	
Professional Competence					
Knowledge	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-poir connections, busses				
Skills	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 computer system and the software executed on it. In particular, they shat 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 proposite feasible options.				
Personal Competence					
Social Competence	Students are able to solv	ve similar problems a	lone or in a group and to pre	esent the resu	Ilts accordingly.
Autonomy	Students are able to account with other classes.	quire new knowledge	e from specific literature and	I to associate	this knowledge
Workload in Hours	IIndependent Study Time	e 124, Study Time in I	ecture 56		
Credit points	<u> </u>	-			
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory  General Engineering Science (German program, 7 semester): Specialisation Process Engineering:  Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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
Accianment for the	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
	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: Compute	er 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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					
- Title			Тур	Hrs/wk	СР
ntroduction to Control Systentroduction to Control Syste	, ,		Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert Werne				
Admission Requirements	None				
Recommended Previous Knowledge	Representation of s	gnals and systems in	time and frequency domain, Lap	lace transfor	rm
Educational Objectives	After taking part suc	essfully, students hav	ve reached the following learning	g results	
Professional Competence					
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>				
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain ar vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>				
Personal Competence					
Social Competence		•	intly solve technical problems,	and experin	nentally valida
Autonomy	experiment guides)	n information from p and use it when solvir	provided sources (lecture note ng given problems. Iy on-line tests and thereby cont		
Workload in Hours	Independent Study	ime 124, Study Time	in Lecture 56		
Credit points	6				
Studienleistung	None				
Examination	Written exam				
Examination duration and scale	120 min				



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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 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	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
	<ul> <li>Nyquist plot, Nyquist stability criterion, phase and gain margin</li> <li>Loop shaping, lead lag compensation</li> <li>Frequency response interpretation of PID control</li> <li>Time delay systems</li> <li>Root locus and frequency response of time delay systems</li> <li>Smith predictor</li> <li>Digital control</li> <li>Sampled-data systems, difference equations</li> <li>Tustin approximation, digital implementation of PID controllers</li> <li>Software tools</li> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, No. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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	



Courses									
litle					-	Тур		Hrs/wk	СР
Semiconductor Circuit Design (L0763) Semiconductor Circuit Design (L0864)					Lecture Recitation Section (sm	nall)	3 1	4 2	
Module Responsible	Prof. Ma	atthias Kuh	nl						
Admission Requirements	None								
Recommended Previous Knowledge			electrical e	engineering					
Educational Objectives	After tal	king part sı	uccessfully	y, students ha	ave reache	d the following lear	ning	results	
Professional Competence									
Knowledge	•	Students I disadvanta Students I specificatio Students a	know the ages. have solid ons. have able to	fundamental knowledge a explain how	digital log about mem analog circ	of different MOS de pic circuits and can nory circuits and can cuits functions and v use of bipolar trans	disc n exp where	cuss their a plain their f e they are a	udvantages a
Skills	•	parameter Students a circuits.	s of electro are able to can use M	onic circuits. o develop di	ifferent log	of different MOS ic circuits and can nal amplifiers and	desi	ign differen	t types of log
Personal Competence	   								
Social Competence	•		working to	-	_	eneous teams. es can solve probl	ems	and answ	er profession
Autonomy	•	Students a	are able to	assess their	level of kno	owledge.			
Workload in Hours	Indeper	ndent Stud	y Time 12	4, Study Time	e in Lecture	e 56			
Credit points	ļ			<u> </u>					
Studienleistung	None								
Examination	Written	exam							
Examination duration and scale	l 120 mir	n							
	Genera Mechat Genera Compu	al Enginee tronics: Co al Enginee Ilsory	ring Scier mpulsory ring Scien	nce (German	program	Specialisation Electr ): Specialisation M 7 semester): Speciali semester): Speciali	lecha alisat	anical Engi	neering, Foc



	Focus Mechatronics: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory	
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus	
Following Curricula	Mechatronics: Compulsory	
. cg carrioana	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Mechatronics: Compulsory	
	Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective	
	Compulsory	
	Mechanical Engineering: Specialisation Mechatronics: Compulsory	
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Core qualification: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	



Course L0864: Semicon	ductor 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
Language	DE
Cycle	SoSe
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>
Literature	R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S  HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674  K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944  U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496  H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867  URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499  URL: http://dx.doi.org/10.1007/978-3-642-20887-4  URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955  URL: http://www.ciando.com/img/bo



Module M0854: Ma	thematics IV			
Courses				
Title	tial Differential Equations) (L1043)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
. ,	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041) Complex Functions (L1042)		Recitation Section (small) Recitation Section (large)	1	1
		riectiation dection (large)	ı	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic conce appropriate examples.</li> <li>Students can discuss logical con illustrating these connections with t</li> <li>They know proof strategies and car</li> </ul>	nections between these conce he help of examples.		_
Skills	<ul> <li>Students can model problems in N course. Moreover, they are capable</li> <li>Students are able to discover and studied in the course.</li> <li>For a given problem, the students of to critically evaluate the results.</li> </ul>	of solving them by applying esta d verify further logical connection	ablished me ons betwee	thods. In the concepts
Personal Competence				
Social Competence	<ul> <li>Students are able to work togeth common language.</li> <li>In doing so, they can communicate partners. Moreover, they can desig peers.</li> </ul>	new concepts according to the	needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking to can specify open questions precise</li> <li>Students have developed sufficient oriented manner on hard problems</li> </ul>	ly and know where to get help in persistence to be able to work f	solving the	m.
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Studienleistung				
	Written exam			
Examination duration and scale		erential Equations 2)		



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

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

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

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

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

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

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

# Assignment for the Following Curricula

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

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

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

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

Focus Theoretical Mechanical Engineering: Compulsory

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

Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory

Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
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	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  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  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1041: Complex Functions		
Тур	Recitation Section (small)	
Hrs/wk	1	
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 M0829: Fo	undations of Management			
Courses				
Title	_	Тур	Hrs/wk	СР
Management Tutorial (L0882 Introduction to Management		Recitation Section (large) Lecture	2	3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busines	SS		
	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	After taking this module, students know the in Management, from Planning and Organisatic and Controlling. In particular they are able to  • explain the differences between Eco	n to Marketing and Innovati	on, and also	o to Investmen
Knowledge	Management and to name important definitions from the field of Management  explain the most important aspects of and goals in Management and name the most import aspects of entrepresental projects		most importan and sourcing ent, information	
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry 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 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	work successfully in a team of students     to apply their knowledge from the lect report on the project     to communicate appropriately and     to cooperate respectfully with their fello	ure to an entrepreneurship p	roject and v	rite a coheren
Autonomy	Students are able to  work in a team and to organize the team to write a report on their project.	m themselves		
	Independent Study Time 110, Study Time in Lo	ecture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek	
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 self-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.	



ırse L0880: Introduct	ion to Management
	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. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: Ad	Ivanced Mechanical Engi	neering Design		
_	•			
Courses		_	, .	
Title Advanced Mechanical Engin	pooring Decign II (L0264)	Тур	Hrs/wk 2	CP
Advanced Mechanical Engir Advanced Mechanical Engir	, ,	Lecture Recitation Section (large)	2	2 1
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, stude	ents have reached the following learning	results	
Professional				
Competence				
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain complex working principles and functions of machine elements and of basic element of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solving skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	Students are able to disc methods.	cuss technical information in the lectu	re supporte	d by activating
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study	/ Time in Lecture 112		
Credit points	6			
Studienleistung	J			
Examination	Written exam			
	i			



Examination duration and scale	
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in 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 Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
Following Curricula	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
	Machanical Engineering: Core qualification: Compulsory

Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



Course L0264: Advance	d Mechanical 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	<del>'</del>	
	Advanced Mechanical Engineering Design I & II	
Content	Fundamentals of the following machine elements:	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage.</li> </ul>	



Course L0265: Advance	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: Advance	d Mechanical 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  • Gear drives  • Gear drives  • Gear drives  • Epicyclic gears  • Crank gears
	<ul> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Course L0263: Advance	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	



Title Production Engineering I (L0608) Lecture Production Engineering I (L0612) Recitation Section (large) Recitation Section (la	Courses				
Production Engineering I (L0608) Production Engineering II (L0612) Production Engineering II (L0612) Production Engineering II (L0611) Recture 2 2 Production Engineering II (L0611) Recture 2 2 Production Engineering II (L0611) Recture 2 2 Rectation Section (large) 1 1 1  Module Responsible   Admission Requirements  Recommended Previous Knowledge  Educational Objectives Professional Competence  Students are able to  • name basic criteria for the selection of manufacturing processes.  • name the main groups of Manufacturing Technology.  • name the main groups of Manufacturing Technology.  • name the main groups of Manufacturing technology.  • name the main groups of Manufacturing technology.  • name the main groups of Manufacturing technology.  • select manufacturing processes.  • describe elements, geometric properties and kinematic variables and requirements for tworkpiece and process.  • explain the essential models of manufacturing technology.  Students are able to  • select manufacturing processes for simple tasks to meet the required tolerances of component to be produced.  • assess components in terms of their production-oriented construction.  Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • interpret independently the manufacturing process.  • assess own strengths and weaknesses in general.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • assess their learning progress and define gaps to be improved.  • ass			Typ	Hre/wk	CD
Production Engineering   (L0612)   Recitation Section (large)   1   1   Production Engineering   (L0610)   Recitation Section (large)   1   1    Module Responsible   Admission   None   Prof. Wolfgang Hintze   Non		1608)			-
Production Engineering II (L611) Rectation Section (large) 1 1  Module Responsible   Admission Requirements  Recommended Previous Knowledge   Tot. Wolfgang Hintze   Tot. Wolfgang Hint	• • •	•			
Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Students are able to  • name basic criteria for the selection of manufacturing processes. • name the main groups of Manufacturing Technology. • name the application areas of different manufacturing processes. • name the application areas of different manufacturing processes. • describe elements, geometric properties and kinematic variables and requirements for the overlying and process. • explain the essential models of manufacturing technology.  Students are able to  • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • assess sheir learning progress and define gaps to be improved. • assess possible consequences of their actions.				2	2
Recommended Previous Knowledge internship recommended internship rec	Production Engineering II (L	0611)	Recitation Section (large)	1	1
Recommended Previous Knowledge Internship recommended Internship rec	Module Responsible	Prof. Wolfgang Hintze			
Recommended Previous Knowledge   Internship recommended		None			
Professional Competence  Students are able to  • name basic criteria for the selection of manufacturing processes. • name the main groups of Manufacturing Technology. • name the application areas of different manufacturing processes. • name boundaries, advantages and disadvantages of the different manufacturing process. • describe elements, geometric properties and kinematic variables and requirements for two rkpiece and process. • explain the essential models of manufacturing technology.  Students are able to • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • assess their learning progress and define gaps to be improved. • assess benefit learning progress and define gaps to be improved. • assess possible consequences of their actions.		·			
Professional Competence  Students are able to  • name basic criteria for the selection of manufacturing processes. • name the main groups of Manufacturing Technology. • name the application areas of different manufacturing processes. • name boundaries, advantages and disadvantages of the different manufacturing process. • describe elements, geometric properties and kinematic variables and requirements for tworkpiece and process. • explain the essential models of manufacturing technology.  Students are able to • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • assess their learning progress and define gaps to be improved. • assess benefit earning progress and define gaps to be improved. • assess possible consequences of their actions.	Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Students are able to  • name basic criteria for the selection of manufacturing processes. • name the main groups of Manufacturing Technology. • name the application areas of different manufacturing processes. • name boundaries, advantages and disadvantages of the different manufacturing process. • describe elements, geometric properties and kinematic variables and requirements for tworkpiece and process. • explain the essential models of manufacturing technology.  Students are able to • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to • develop solutions in a production environment with qualified personnel at technical level represent decisions.  **Students are able to • interpret independently the manufacturing process. • 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*				,	
• name basic criteria for the selection of manufacturing processes.     • name the main groups of Manufacturing Technology.     • name boundaries, advantages and disadvantages of the different manufacturing processes.     • name boundaries, advantages and disadvantages of the different manufacturing process.     • describe elements, geometric properties and kinematic variables and requirements for the workpiece and process.     • explain the essential models of manufacturing technology.  Students are able to  • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • interpret independently the manufacturing process. • 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					
• name basic criteria for the selection of manufacturing processes.     • name the main groups of Manufacturing Technology.     • name basic criteria for the selection of manufacturing processes.     • name the application areas of different manufacturing processes.     • name boundaries, advantages and disadvantages of the different manufacturing process.     • describe elements, geometric properties and kinematic variables and requirements for the workpiece and process.     • explain the essential models of manufacturing technology.  Students are able to  • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of component to be produced. • assess components in terms of their production-oriented construction.  Personal Competence  Students are able to • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to • interpret independently the manufacturing process. • 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	•	Students are able to			
select manufacturing processes in accordance with the requirements.     design manufacturing processes for simple tasks to meet the required tolerances of component to be produced.     assess components in terms of their production-oriented construction.  Personal Competence  Students are able to      develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to      interpret independently the manufacturing process.     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	Knowledge	<ul> <li>name the main groups of Manufactu</li> <li>name the application areas of difference</li> <li>name boundaries, advantages and describe elements, geometric proposition</li> <li>workpiece and process.</li> </ul>	ring Technology.  ent manufacturing processes.  disadvantages of the different retries and kinematic variables		
Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • interpret independently the manufacturing process.  • 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	Skills	<ul> <li>select manufacturing processes in accordance with the requirements.</li> <li>design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.</li> </ul>			
Students are able to  • develop solutions in a production environment with qualified personnel at technical level represent decisions.  Students are able to  • interpret independently the manufacturing process.  • 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	Personal Competence				
Students are able to  • interpret independently the manufacturing process. • 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	<b>,</b>	Students are able to			
interpret independently the manufacturing process.     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	Social Competence	develop solutions in a production e	nvironment with qualified pers	onnel at tec	hnical level ar
Credit points 6	Autonomy	<ul> <li>interpret independently the manufact</li> <li>assess own strengths and weaknest</li> <li>assess their learning progress and</li> </ul>	ses in general. define gaps to be improved.		
Credit points 6	Workload in Hours	Independent Study Time 96, Study Time in	_ecture 84		
		<u> </u>			
<u> </u>					
Examination Written exam					



and scale	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the Following Curricula	Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German 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: Elective Compulsory

Course L0608: Production	on 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	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
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)

ourse 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	on 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	<ul> <li>Geometrically undefined machining (grinding, lapping, honing)</li> <li>Introduction into erosion technology</li> <li>Introduction into blastig processes</li> <li>Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites)</li> <li>Fundamentals of Laser Technology</li> <li>Process versions and Fundamentals of Laser Joining Technology</li> </ul>
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005)  Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007)  Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.]: Hanser, 1981  Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie: Technologien und Werkstoffe. Berlin [u.a.]: Springer, 2007

Course L0611: Production 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	



Courses				
Title Advanced Mechanical Design Project (L0266)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk	<b>CP</b>
Module Responsible	Dr. Jens Schmidt			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Mechanical Engineering:</li><li>Advanced Mechanical Er</li></ul>	=		
Educational Objectives	After taking part successfully, stu	dents have reached the following learnin	g results	
Professional Competence				
Knowledge	<ul> <li>explain guidelines for des</li> </ul>		s,	
Skills	<ul> <li>convert principle solution</li> <li>use methods to design oriented,</li> <li>create a technical docum functions of the system,</li> </ul>	nd develop principle solutions using sketo	systematicall	
Personal Competence				
Social Competence		ts are able to: ions and technical drawings within group he work groups of the course	os,	
Autonomy		mplex design projects, while motivad	ting themse	elves, acquirin
Workload in Hours	Independent Study Time 124, St	udy Time in Lecture 56		
Credit points				
Studienleistung	Yes None Attest	<b>Description</b> ation		
	Written exam			
Examination duration and scale	180			
	Aircraft Systems Engineering: Co General Engineering Science Product Development and Produ General Engineering Science Theoretical Mechanical Enginee	German program): Specialisation Mec ction: Compulsory (German program): Specialisation Mec ring: Compulsory erman program, 7 semester): Specialisat	hanical Eng	ineering, Focu



# Assignment for the Following Curricula

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

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

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

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Course L0266: Advance	d 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
	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.  • Getriebekonstruktion in Einzelarbeit
Content	<ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> <li>Lösungsfindung</li> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Module M0726: Pr	oduction Technology			
Courses				
Title Fundamentals of Machine Tools (L0689) Fundamentals of Machine Tools (L1992) Forming and Cutting Technology (L0613) Forming and Cutting Technology (L0614)		Typ Lecture Recitation Section (larg Lecture Recitation Section (larg	2	<b>CP</b> 2 1 2
	Prof. Wolfgang Hintze	(	-, .	
Admission Requirements				
Recommended Previous Knowledge	without major course assessment internship recommended Previous knowledge in mathematics, me	chanics and electrical engineer	ing	
Educational Objectives	After taking part successfully, students ha	ave reached the following learn	ing results	
Professional Competence				
Knowledge	<ul> <li>explain the basics of chip formation and mechanisms and models of machining.</li> <li>explain methods and parameters for design and analysis of metal forming, machining processes and tools.</li> </ul>			
Skills	Students are able to  select tool geometry, cutting materials, process parameters and appropriate measurin technique in accordance with the requirements.  estimate occurring forces and temperatures during chip formation.  select appropriate machine tools for machining and create NC programs for turning an milling.  assess the quality of a machine tools and to detect weak points.			
Personal Competence	! !			
Social Competence	Students are able to      develop solutions in a production environment with qualified personnel at technical level 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			
Studienleistung	None			
Examination	Written exam			



Examination duration	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory



Course L0689: Fundame	entals of Machine Tools
Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	
	Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
Content	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
Literature	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: Fundame	ourse 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		

se 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	<ul> <li>Thermomechanical Principles and Models of Machining</li> <li>Chip Formation, Forces, Temperature and Tribology process</li> <li>Wear mechanisms and wear patterns</li> <li>Machinability by Cutting and Forming, Specific Problems of Light Weight Structures</li> <li>Cutting Material and Coatings</li> <li>Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools</li> </ul>
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	



Courses					
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032			Typ Lecture	Hrs/wk	<b>CP</b> 4
	·		Recitation Section (small)	1	2
Module Responsible Admission					
Requirements	None				
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:  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 of 4,3 up to 4,0 is not possible.				
<b>Educational Objectives</b>	After taking part success	sfully, students have re	ached the following learning	results	
Professional Competence					
Competence	] 	the foundations of the	functionality of computing	evetame It co	overs the laver
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poi connections, busses</li> </ul>				
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the interr structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors.  After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they shounderstand the consequences that the execution of software has on the hardware-centric abstractil 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.				yze, how highly le components yers of today' erdependencie ular, they sha ntric abstraction to evaluate the
Personal Competence					
Social Competence	Students are able to solv	ve similar problems ald	one or in a group and to pres	sent the resu	lts 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	e 124, Study Time in Le	ecture 56		
Credit points	6				
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
4114 00410	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering 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
Assignment for the	General Engineering Science (English program): Core qualification: Compulsory
Following Curricula	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: 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: Compute	er 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer 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						
Γitle				Тур	Hrs/wk	СР
ntroduction to Control Systentroduction to Control Syste	, ,			Lecture Recitation Section (small)	2 ) 2	4 2
Module Responsible	Prof. Herbert	Werner				
Admission Requirements	None					
Recommended Previous Knowledge		on of signals and	systems in time an	d frequency domain, Lap	lace transfor	rm
Educational Objectives	After taking p	art successfully, s	tudents have reacl	ned the following learning	g results	
Professional Competence						
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>					
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>					
Personal Competence						
Social Competence		_	roups to jointly so	lve technical problems,	and experim	nentally valida
Autonomy	their controller designs  Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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 Lect	re 56		
Credit points		. Clady Time 124,	Judy Timo III Lecti	2.000		
Studienleistung	l					
	Written exam	1				
Examination duration and scale						



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

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

### Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion 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 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			
	<ul> <li>Frequency response interpretation of PID control</li> <li>Time delay systems         <ul> <li>Root locus and frequency response of time delay systems</li> <li>Smith predictor</li> </ul> </li> <li>Digital control         <ul> <li>Sampled-data systems, difference equations</li> <li>Tustin approximation, digital implementation of PID controllers</li> </ul> </li> <li>Software tools         <ul> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul> </li> </ul>			
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>			



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	



Courses					
Γitle			Тур	Hrs/wk	СР
CAE-Team Project (L0271)			Project-/problem-based Learning	2	2
Development of Lightweight	Design Products (L0270)		Lecture	2	2
ntegrated Product Develop	ment I (L0269)		Lecture	2	2
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
	Advanced Knowledge a	bout engineering design:			
_		nical Engineering Design			
Recommended Previous Knowledge	Mechanical Engineering	a: Desian			
		-			
	Advanced Mechanical E	ingineering Design			
		sfully, students have reach	ed the following learning	results	
Professional Competence					
Compotonic	<b>¦</b>	dule, students are capable	e of:		
Knowledge	explaining the full	nctional principle of 3D-C	AD-Systems PDM- and I	FEM-System	s
Tinewieage		teraction of the different C			
	A Grand and the state of the st	d la state de la companie de la tra			
	After completing the mod	dule, students are able to:			
Skills	<ul> <li>evaluate different</li> </ul>	nt CAD- and PDM-System	•	sired require	ements such a
		nemes and product structure plary product using CAD-, I		ns with share	ed workload
			·		
Personal Competence	! 	d la state de la companie de la tra			
	After completing the mod	dule, students are able to:			
Social Competence	<ul> <li>To develop a progroup discussion</li> </ul>	oject plan and allocate wo	ork appropriate work pa	ckages in th	ne framework
		esults as a team for instan	ce in a presentation		
	Students are capable of:	:			
Autonomy	·	dapt to a CAE-Tool and co	amploto a given practical	tack with it	
	- independently at	dapt to a OAL-1001 and co	mpiete a given practical	task with it	
	J	96, Study Time in Lecture	e 84		
Credit points	J				
Studienleistung	Compulsory Bonus	Form Subject theoretical	<b>Description</b> and CAE-Teamproje	ekt inkl.	Vortrag un
Otadiomoiotang	Yes 20 %	practical work	Ausarbeitung	art IIIRI.	vortrag un
Examination	Written exam				
Examination duration and scale	90				
and could	General Engineering S	Science (German prograr	m): Specialisation Mech	anical Engi	neering, Foci
	Aircraft Systems Engine			_	



	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	Mechanical Engineering: Specialisation Product Development and Production: Compulsory  Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory
	Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory

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



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

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



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Courses				
Title	eramics and Polymers (L1233)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
	eramics and Polymers (L1234)	Recitation Section (large)	1	1
Enhanced Fundamentals: M		Lecture	2	3
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
- 4	Module "Fundamentals of Materials Scien	ce"		
Recommended Previous Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students have	re reached the following learning	results	
Professional Competence				
Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, electrical and mass transport, microstructure and phase diagrams. They are capable to explain the			
Skills	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.			
Personal Competence				
Social Competence				
Autonomy	The students are capable to understand in and polymers. They should be able to crita		•	
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German program): 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 Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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 Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Course L1233: Enhance	d Fundamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
	1. Einführung
	Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vor Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik Sprühtrockner
	3. Formgebung
	Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte)
Content	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
	Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Application 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
	[5.40]



	D. Munz, T. Fett, Ceramics, Springer, 2001	
Literature		
	Polymerwerkstoffe	l
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;	l
	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. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1086: Enhance	d Fundamentals: Metals		
Тур	Lecture		
Hrs/wk			
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	<ul> <li>Enhanced Fundamentals of Metals:</li> <li>Introduction to phenomenological thermodynamics</li> <li>Elasticity</li> <li>Thermal materials behavior (heat capacity, thermal expansion)</li> <li>Conductors, semiconductors, isolators: conduction mechanisms and band structure</li> <li>Superconductors</li> <li>Dry corrosion</li> <li>Electrochemistry in the material sciences</li> <li>Wet corrosion</li> <li>Alloy corrosion</li> <li>Corrosion protection</li> <li>Stainless steel</li> <li>Battery materials</li> <li>Supercapacitors</li> <li>Fuel cells</li> <li>Materials for hydrogen storage</li> <li>Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism</li> <li>Magnetic materials: applications</li> </ul>		
Literature	Vorlesungsskript		



Module M0829: Fo	undations of Management			
Courses		<b>T</b>	11 /	O.D.
Title Management Tutorial (L088)	2)	<b>Typ</b> Recitation Section (large)	Hrs/wk 2	<b>CP</b> 3
Introduction to Management		Lecture (large)	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge		3		
<b>Educational Objectives</b>	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to  • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management  • explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects  • describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and 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 and uncertainty, and explain some basic methods from mathematical Finance  • state basics from accounting and costing and selected controlling methods.			
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out 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 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  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a cohe		rite a coherer	
Autonomy	Students are able to  work in a team and to organize the team to write a report on their project.	n themselves		
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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



ırse L0880: Introduct	ion 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. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona			
Language	DE			
Cycle	WiSe/SoSe			
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>			
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 200 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., Stu 2008.  Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgen 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: Ad	Ivanced Mechanical Enginee	ring Design		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir Advanced Mechanical Engir		Recitation Section (large) Lecture	2	1 2
Advanced Mechanical Engir Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible	,	(3.)		
Admission	None			
Requirements	110110			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learning	results	
Professional				
Competence	After passing the module, students are a	able to:		
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic element of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	After passing the module, students are able to:  accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically.			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration				



#### and scale 120

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

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

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

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

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

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

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

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

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

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

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

### Assignment for the

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Following Curricula 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: Advance	d Mechanical Engineering Design II		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
Content	Advanced Mechanical Engineering Design I & II  Lecture  • Fundamentals of the following machine elements:  • Linear rolling bearings  • Axes & shafts  • Seals  • Clutches & brakes  • Belt & chain drives  • 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  • Belt & chain drives  • Gear drives  • Crank gears  • Crank gears  • Sliding bearings  • Calculations of hydrostatic systems (fluidics)		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>		



Course L0265: Advance	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: Advance	d Mechanical 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  • Belt & chain drives  • Gear drives  • Gear drives  • Epicyclic gears  • Crank gears  • Sliding bearings
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course L0263: Advance	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: Sig	gnals and Systems			
Courses				
litle little		Тур	Hrs/wk	СР
Signals and Systems (L043)	2)	Lecture	3	4
Signals and Systems (L043	3)	Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements				
	Mathematics 1-3			
	The modul is an introduction to the theor covered by the moduls Mathematik 1-3 is a (Fourier series, Fourier transform, Laplace to	expected. Further experience w	ith spectral	-
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and described methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal.	ey are able to apply the fund and systems. They can describe time and image domain. In par	amental tra e and analy ticular, they	nsformations on se deterministi understand th
Skills	The students are able to describe and anal using methods of signal and system theor important properties such as magnitude an the impact of LTI systems on the signal prop	y. They can analyse and desigd phase response, stability, line	n basic sys earity etc T	tems regardin
<b>Personal Competence</b>				
Social Competence	The students can jointly solve specific probl	ems.		
Autonomy	The students are able to acquire relevant control their level of knowledge during the clicker system.			-
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	190 min			
	General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces on program): Specialisation on program): Specialisation on program): Specialisation Biomedical gram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 s	Science: Congineering: s Engineeri Civil- and Mechanica al Engineeri tion Electricisation Conation Proces	ompulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science



Focus Biomechanics: Compulsory

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

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

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

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

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

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

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

Compulsory

Assignment for the

**Following Curricula** 

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



Course L0433: Signals a	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			Гур	Hrs/wk	СР
Advanced Mechanical Desi	gn Project (L0266)		Project-/problem-based Learning	4	6
Module Responsible	Dr. Jens Schmidt				
Admission Requirements	None				
Recommended Previous Knowledge	<ul><li>Mechanical Engineerin</li><li>Advanced Mechanical I</li></ul>	-			
Educational Objectives	After taking part successfully, s	tudents have reached	d the following learning	results	
Professional Competence					
	After passing the module, stude	ents are able to:			
	express the procedure to the second sec	or systematically har	ndling of		
Knowledge	<ul><li>complex design tasks ,</li><li>describe working princi</li></ul>	ples, their use and co	ombination possibilities	,	
	<ul> <li>explain guidelines for d</li> </ul>	esigning for function	and manufacturing,		
	explain advanced use-o	oriented knowledge d	of machine elements.		
	After passing the module, stude	ents are able to:			
	analyze complex tasks and develop principle solutions using sketches,				
Skills	<ul> <li>convert principle solutions into a detailed design,</li> <li>use methods to design and solve engineering design tasks systematically and solution-</li> </ul>				
Skills	oriented,     create a technical documentation including all necessary technical drawings to understand the				
	functions of the system,	mentation including a	an necessary technical	urawings to	understand ti
	<ul> <li>document calculations</li> </ul>	of selected machine	elements clearly and in	detail.	
Personal Competence					
	After passing the module, stude	ents are able to:			
Social Competence	<ul><li>present and discuss so</li><li>reflect the own results in</li></ul>			5,	
	After passing the module, stude	ents are able to:			
<b>A</b> . (	<ul> <li>independently solve</li> </ul>	complex design pr	ojects, while motivati	ing themse	lves, acquirir
Autonomy	necessary knowledge a		riate methods,	_	·
	to independently solve	problems.			
	Independent Study Time 124, S	Study Time in Lecture	9 56		
Credit points					
Studienleistung	Yes None Atte	<b>m</b> station	Description		
Examination	Written exam				
Examination duration and scale	180				
	General Engineering Science		: Specialisation Mech	anical Eng	ineering, Foci
	Aircraft Systems Engineering: General Engineering Science		r Specialisation Mech	anical Engi	ineering Foo
	Product Development and Product	duction: Compulsory			
	General Engineering Science Theoretical Mechanical Engine		: Specialisation Mech	anical Engi	ineering, Foci
	General Engineering Science		semester): Specialisatio	on Mechanio	cal Engineerir
	Focus Aircraft Systems Engine	ering: Compulsory			



### Assignment for the Following Curricula

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

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

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

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Course L0266: Advance	d 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	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Courses							
Title			Тур		Hrs/wk	СР	
Heat Transfer (L0458) Heat Transfer (L0459)			Lecture Recitation Section (la	rge)	3 2	4 2	
Module Responsible	Dr. Andreas Moschallski						
Admission Requirements	None						
Recommended Previous Knowledge	Technical Thermodynamics I, II	and Fluid D	ynamics				
Educational Objectives	After taking part successfully, s	tudents have	reached the following lea	rning	results		
Professional Competence							
	The students are able to						
	- describe the different physical	mechanism	of Heat Transfer,				
Knowledge	- explain the technical terms,						
	- to analyse comlex heat transfe	er processes	in a critical way.				
	The students are able to						
	- understand the physics of Hea	at Transfer,					
Skills	• •		sfer processes,				
	- solve excersises self-consiste	nt and in sm	all groups.				
Personal Competence							
Social Competence	The students are able to discus	s in small gr	oups and develop an appr	oach.			
	The students are able to dev critical way. A qualified exchan			ent an	d analyse	the resul	ts in
Workload in Hours	Independent Study Time 110, S	Study Time in	L ecture 70				
Credit points		otady Timo II	1 2001010 70				
Studienleistung							
Examination	Written exam						
Examination duration and scale	120 min						
	General Engineering Science Biomechanics: Compulsory General Engineering Science Energy Systems: Compulsory General Engineering Science ( General Engineering Science Theoretical Mechanical Engine General Engineering Science ( Focus Energy Systems: Compu General Engineering Science ( Focus Theoretical Mechanical	(German pro (German pro (German pro German pro Ilsory German pro Engineering	program): Specialisation I gram): Specialisation Biomorgam): Specialisation I ulsory gram, 7 semester): Special gram, 7 semester): Special	Mecha nedica Mecha lisatio	anical Engi Il Engineeri anical Engi n Mechanic	neering, ng: Comp neering, cal Engine	Foci oulso Foci eerin eerin
	General Engineering Science ( Compulsory	•					
Assignment for the Following Curricula	General Engineering Science ( General Engineering Science Biomechanics: Compulsory	(English p	rogram): Specialisation I	Mecha	anical Engi	neering,	Foc
	General Engineering Science Energy Systems: Compulsory General Engineering Science					_	
	General Engineening Science	: (⊏ngnsn t	rogram): Specialisation i	viecna	unicai ⊑nui	neenng.	LO



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

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Course L0458: Heat Tra	nsfer
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	<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996</li> </ul>

Course L0459: Heat Tra	nsfer
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



					<u>.</u>
Courses					
Title			Тур	Hrs/wk	CP
Computer Engineering (L032 Computer Engineering (L032			Lecture Recitation Section (small)	3 1	4 2
Module Responsible	Prof. Heiko Falk				
Admission					
Requirements	Basic knowledge in elec	trical anainaarina			
Recommended Previous Knowledge	The successful comple examination according to  1. Upon a passed marks due to the	etion of the labs will be the following rules: module examination, the successful labs, such	e honored during the e student is granted a that the examination's m	bonus on the	e examination'
		o the next-better grade. t of the grade 5,0 up to 4	,3 and of 4,3 up to 4,0 is r	not possible.	
Educational Objectives	After taking part success	fully, students have reac	hed the following learnin	g results	
Professional Competence					
Knowledge	from the assembly-level Introduction Combinational I combinational ne Sequential logic: Technological for Computer arithme Basics of compipelining Memories: Memo Input/output: I/O connections, bus	ogic: Gates, Boolean atworks Flip-flops, automata, sysundations etic: Integer addition, substituter architecture: Progray hierarchies, SRAM, Darry	algebra, Boolean fundational stematic hardware design obtraction, multiplication argramming models, MIPS RAM, caches the CPU, principles of the architect's perspective, uter systems. The stude eased on a collection of the explain the different as a complete processors.	s the following tions, hardy and division S single-cyc passing data i.e., they idents can analyfew and simplestraction language the interit. In partic hardware-ce be enabled	g topics:  vare synthesis  le architecture  a, point-to-poin  ntify the interna  yze, how highly  le component  yers of today  erdependencie  ular, they sha  ntric abstractio  to evaluate th
Personal Competence	·				
Social Competence	Students are able to solv	re similar problems alone	e or in a group and to pre	sent the resu	Its accordingly
Autonomy	Students are able to acc with other classes.	quire new knowledge fro	om specific literature and	to associate	this knowledg
Workload in Hours	Independent Study Time	124, Study Time in Lect	ure 56		
Credit points	<u> </u>	<u>-</u>			
	Compulsory Bonus	Form	Description		



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus 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
Assianment for the	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: 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Computer 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				
Title		Тур	Hrs/wk	СР
Introduction to Control Syste Introduction to Control Syste	, ,	Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	-	tems in time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, stude	ents have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	vice versa  They can simulate and asset They can design PID control  They can analyze and so frequency response technice  They can calculate discretiand use it for digital implements	te-time approximations of controllers de	loops lichols) tuning the help of esigned in	ng rules root locus an continuous-tim
Personal Competence				
Social Competence	Students can work in small group their controller designs	os to jointly solve technical problems, a	and experim	nentally validat
Autonomy	Students can obtain information experiment guides) and use it whe	from provided sources (lecture notes on solving given problems. In weekly on-line tests and thereby contro		
Workload in Houre	Independent Study Time 124, Stud	ly Time in Lecture 56		
Credit points	<u> </u>	., 200.010 00		
Studienleistung				
	Written exam			
Examination duration and scale				
	120 min  General Engineering Science (Ger	rman program): Core qualification: Comp German program, 7 semester): Special	-	nputer Scie



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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

ourse L0654: Introduction 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 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	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>	



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	



Courses				
Title		Тур	Hrs/wk	СР
Production Engineering I (L0	608)	Lecture	2	2
Production Engineering I (L0	612)	Recitation Section (larg	e) 1	1
Production Engineering II (LC	•	Lecture	2	2
Production Engineering II (LC	0611)	Recitation Section (larg	e) 1	1
Module Responsible	Prof. Wolfgang Hintze			
Requirements	None			
Recommended	no course assessments required			
	internship recommended			
<b>Educational Objectives</b>	After taking part successfully, students h	ave reached the following learn	ing results	
Professional				
Competence				
	Students are able to			
Knowledge	<ul> <li>name basic criteria for the select</li> <li>name the main groups of Manufa</li> <li>name the application areas of di</li> <li>name boundaries, advantages a</li> <li>describe elements, geometric p workpiece and process.</li> <li>explain the essential models of r</li> </ul>	acturing Technology.  Iferent manufacturing processes and disadvantages of the differer roperties and kinematic variables.	s. nt manufacturir	
Skills	select manufacturing processes in accordance with the requirements.     design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.     assess components in terms of their production-oriented construction.			
Personal Competence				
	Students are able to			
Social Competence	<ul> <li>develop solutions in a production represent decisions.</li> </ul>	on environment with qualified pe	ersonnel at tec	chnical level ar
Autonomy	Students are able to  • interpret independently the manual eassess own strengths and weakted eassess their learning progress are assess possible consequences of	nesses in general. and define gaps to be improved.		
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points				
Studienleistung				
Examination				



and scale	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the	Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German 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: Elective Compulsory

Course L0608: Production	on 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	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
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	<ul> <li>Geometrically undefined machining (grinding, lapping, honing)</li> <li>Introduction into erosion technology</li> <li>Introduction into blastig processes</li> <li>Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites)</li> <li>Fundamentals of Laser Technology</li> <li>Process versions and Fundamentals of Laser Joining Technology</li> </ul>	
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.]: Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie: Technologien und Werkstoffe. Berlin [u.a.]: Springer, 2007	

Course L0611: Production 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 M1320: Si	mulation and Design of Mechatro	nic Systems		
Courses				
Title Simulation and Design of Mechatronic Systems (L1822) Simulation and Design of Mechatronic Systems (L1823) Simulation and Design of Mechatronic Systems (L1824)		Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	INONE			
Recommended Previous Knowledge	I Filingatmentale of mechanice, control theory and electrical engineering			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students are able to describe methods and calculations for design, modeling, simulation and optimization of mechatronic systems.			
Skills	Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence				
Social Competence	Ct. dente are able to wark and ariented in small mixed are used an according to the terms to are a			
Autonomy	Students are able to recognize and improve knowledge deficits independently.  With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in I	Lecture 56		
Credit points	6			
Studienleistung	None			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula		ogram): Specialisation Mecholsory ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation record of the semester ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation ram, 7 semester): Specialisation	nanical Enginanical  ineering, Foculineering, Focul Engineering cal Engineering Foculineering, Foculineering, Foculineering, Foculineering, Foculineering, Foculineering, Foculineering, Foculineering, Foculineering	



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory 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	ourse 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 M0854: Ma	thematics IV			
Courses				
Title	tial Differential Equations) (L1043)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
. ,	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture Recitation Section (small)	2	1
. ,	Complex Functions (L1041)		1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in thi course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperating</li> </ul>			
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Studienleistung				
	Written exam			
Examination duration and scale		erential Equations 2)		



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

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

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

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

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

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

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

## Assignment for the Following Curricula

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

Theoretical Mechanical Engineering: Compulsory

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

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

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

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

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory 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

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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  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: Different	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	
Content	Main features of complex analysis  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation	
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html	

Course L1041: Complex Functions		
Тур	Recitation Section (small)	
Hrs/wk	1	
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



Madula Macaa	deliene of New			
Module M0829: Fo	undations of Management			
Courses				
Title	0)	Typ	Hrs/wk	CP
Management Tutorial (L0882 Introduction to Management		Recitation Section (large) Lecture	2 3	3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	INANA			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
<b>Educational Objectives</b>	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
	After taking this module, students know the implement, from Planning and Organisation and Controlling. In particular they are able to  • explain the differences between Ecor	to Marketing and Innovati	on, and also	o to Investmen
Knowledge	Management and to name important det     explain the most important aspects of an aspects of entreprneurial projects     describe and explain basic business supply chain management, organizati management, innovation management are explain the relevance of planning and multiple objectives and uncertainty, a Finance     state basics from accounting and costing	nd goals in Management ar functions as production, p on and human ressource and marketing decision making in Busine nd explain some basic m	orocurement managementss, esp. in sethods from	and sourcing ent, information ituations unde
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry 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 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  work successfully in a team of students to apply their knowledge from the lecture report on the project to communicate appropriately and to cooperate respectfully with their fellow		roject and v	vrite a coheren
Autonomy	Students are able to  work in a team and to organize the team to write a report on their project.	themselves		
	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



## and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

Compulsory

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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



ırse L0880: Introduct	ion to Management			
	Lecture			
Hrs/wk	3			
СР	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona			
Language	DE			
Cycle	WiSe/SoSe			
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supp Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strateginformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>			
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: Fu	ndamentals of Materials Sci	ence			
Courses					
Title Fundamentals of Materials S Fundamentals of Materials	Science I (L1085) Science II (Advanced Ceramic Materials,	Typ Lec Polymers and	ture	Hrs/wk 2 2	<b>CP</b> 2
Composites) (LU506)	cs of Materials Science (L1095)	Lec		2	2
	Prof. Jörg Weißmüller				
Admission Requirements					
Recommended Previous Knowledge	Highschool-level physics, chemistry u	nd mathematics			
	After taking part successfully, students	have reached th	ne following learning i	results	
Professional Competence					
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.				
Skills	The students are able to trace mate laws of nature. Materials phenomena and stiffness, chemical properties suc solidification, precipitation, or meltin conditions and the materials microstr the material's behavior.	here refers to make has corrosion region for the students	nechanical properties esistance, and to phas can explain the rela	such as str se transform ation betwe	ength, ductility, nations such as en processing
Personal Competence					
Social Competence					
Autonomy	-				
	Independent Study Time 96, Study Time	ne in Lecture 84			
Credit points	-				
Studienleistung Examination	None Written exam				
Examination duration and scale	180 min				



General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and **Environmental Engineering: Compulsory** Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Assignment for the Engineering: Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective 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 of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider	
Language	DE	
Cycle	SoSe	
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7	

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



Module M0730: Co	mputer Engineeri	ing					
Courses							
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032	,	Typ Lecture Recitation Section (smal	Hrs/wk 3 II) 1	<b>CP</b> 4 2			
Module Responsible	Prof. Heiko Falk						
Admission Requirements	None						
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:  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 of 4,3 up to 4,0 is not possible.						
	ļ	sfully, students have re	eached the following learning	ng results			
Professional Competence							
Knowledge	<ul> <li>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:         <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> </li> <li>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</li> </ul>						
Skills	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 computer 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 acquire new knowledge from specific literature and to associate this knowledge with other classes.						
Workload in Hours	Independent Study Time	= 124, Study Time in L	ecture 56				
Credit points							
	Compulsory Bonus Form Description Yes 10 % Excercises						



Examination duration and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus 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
Assianment for the	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: 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: Compute	r Engineering				
Тур	Lecture				
Hrs/wk	3				
СР					
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42				
Lecturer	Prof. Heiko Falk				
Language	DE				
Cycle	WiSe				
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>				
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>				

Course L0324: Computer 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						
Title	Тур		Hrs/wk	СР		
Fluid Mechanics (L0454)	Lecture		3	4		
Fluid Mechanics (L0455)	Recitation Section	(large)	2	2		
Module Responsible	Prof. Thomas Rung					
Admission Requirements	None					
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mecha	anics an	d thermodyr	namics.		
Educational Objectives	After taking part successfully, students have reached the following	earning	results			
Professional Competence						
Knowledge	Students will have the required sound knowledge to explain the ge and physics of fluids. Students can scientifically outline the mathematical models and are familiar with methods for the perform fluid engineering devices.	rationa	ale of flow	physics using		
Skills	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 scientific level.					
Personal Competence						
Social Competence	The students are able to discuss problems and jointly develop solu	tion stra	tegies.			
Autonomy	The students are able to develop solution strategies for complex panalyse results.	roblems	self-consist	ent and crticall		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points	6					
Studienleistung	None					
Examination	Written exam					
Examination duration and scale	180 min					
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Bit General Engineering Science (German program): Specialisation Bit General Engineering Science (German program): Specialisation Not General Engineering Science (German program, 7 semester): Specialisation Not General Engineering Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Specialisation Science (German program, 7 semester): Compulsory General Engineering Science (German program, 7 semester): Compulsory General Engineering Science (English program): Specialisation Metageneral Engineering Science (English program): Specialisation Not General Engineering Science (English program, 7 semester): Specialisation Science (English program): Specialisation Science (English program): Specialisatio	omedica aval Arc cialisation cialisation Special echanica predica aval Arcl cialisation cialisation	al Engineeri chitecture: Co con Mechanic con Biomedic disation Nav al Engineeri chitecture: Co con Mechanic con Biomedic	ng: Compulsory cal Engineering al Architecture ng: Compulsory ng: Compulsory mpulsory cal Engineering		



Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Course L0455: Fluid Mechanics			
Тур	Typ 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 M0672: Sid	gnals and Systems						
Module Moorz. Sig	griais and Systems						
Courses							
Title		Тур	Hrs/wk	CP			
Signals and Systems (L043) Signals and Systems (L043)		Lecture Recitation Section (small)	3	4 2			
Module Responsible	Prof. Gerhard Bauch						
Admission Requirements	None						
- 4	Mathematics 1-3						
	The modul is an introduction to the theory o covered by the moduls Mathematik 1-3 is experience (Fourier series, Fourier transform, Laplace transform).	ected. Further experience w	ith spectral				
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results				
Professional Competence							
Knowledge	The students are able to classify and describe methods of signal and system theory. They continuous time and discrete time signals and	are able to apply the funda systems. They can describe te and image domain. In par	amental trai e and analys ticular, they	nsformations of se deterministic understand the			
Skills	The students are able to describe and analyse using methods of signal and system theory. T important properties such as magnitude and p the impact of LTI systems on the signal properti	hey can analyse and desig hase response, stability, line	n basic sys arity etc T	tems regarding			
Personal Competence							
Social Competence	The students can jointly solve specific problems	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.					
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70					
Credit points	6						
Studienleistung	None						
Examination	Written exam						
Examination duration and scale	19() min						
	General Engineering Science (German programa General Engineering Science (German programa General Engineering Science (German programa General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German programa General Engineering Science (German programa General Engineering Science (German programa General Engineering Science (German programa Engineering Science (German programa General Engineering Science (German programa Engineering Science (German programa General Engineering Science (German programa Engineering Science (German programa Compulsory General Engineering Science (German programa Compulsory General Engineering Science (German programa Compulsory	m): Specialisation Process Em): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation Biomedica am, 7 semester): Specialisation am, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation	ngineering: s Engineering civil- and Mechanical al Engineerin cion Electric sation Com ation Proces on Bioproces	Compulsory ng: Compulsory Enviromenta Engineering ng: Compulsory al Engineering uputer Science as Engineering as Engineering as Engineering			
	General Engineering Science (German program	,	22.70	g9			



Focus Biomechanics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: 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 Mechatronics: Compulsory

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

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

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

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	and Systems					
Тур	Lecture					
Hrs/wk	3					
CP						
	Independent Study Time 78, Study Time in Lecture 42					
Language	Prof. Gerhard Bauch					
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	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>					



Course L0433: Signals and Systems				
Тур	Typ 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 M0960:	Mechanics	IV (Kinetics	II,	Oscillations,	Analytical	Mechanics,	Multibody
Systems)							

Courses					
Title	Oscillations Analytical Masher	nios Multibody Cys	Typ	Hrs/wk	СР
(L1137)	Oscillations, Analytical Mechan		Lecture	3	3
(L1130)			tems) Recitation Section (small)	2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechan	nics, Multibody Sys	tems) Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics I-III and Mecha	unics I-III			
	After taking part successfully	y, students have r	eached the following learning	results	
Professional Competence					
	The students can				
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>				
Skills	The students can  explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;  apply basic methods to engineering problems;  estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.				
Personal Competence Social Competence	The students can work in gr	oups and support	each other to overcome diffict	ulties.	
	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				
Studienleistung	' '	<b>Form</b> Midterm	<b>Description</b> Wird nur im SoS	e angebote	n
Examination	Written exam				
Examination duration and scale	120 min				
	Compulsory General Engineering Science General Engineering Science General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science	ce (German progr ce (German progr ce (German progr ce (German progr nce (German pro	program): Specialisation  am): Specialisation Biomedica am): Specialisation Naval Arcl am, 7 semester): Specialisation  ram, 7 semester): Specialisation  ogram, 7 semester): Specialisation  ogram, 7 semester): Specialisation  sam): Specialisation Mechanica am): Specialisation Biomedica	al Engineeri hitecture: Co on Mechanic on Biomedic isation Nav al Engineerii	ompulsory cal Engineering cal Engineering al Architecture ng: Compulsory



Assignment for the	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Technomathematics: Core qualification: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory

Course L1137: Mechanic	cs 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	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</li> </ul>
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	



Courses				
Title		Typ	Hrs/wk	СР
Introduction to Anatomy (L0	384)	<b>Typ</b> Lecture	2	3
Module Responsible	Prof. Udo Schumacher			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students ha	ve reached the following le	earning results	
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeleta			
Skills	The students can recognize the relationship between given anatomical facts and the development o some common diseases; they can explain the relevance of structures and their functions in the contex of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in curren professional level.	t discussions in biomedi	cal research and	medicine on a
Autonomy	The students are able to access ar conversations on the topic and acquire th			participate ii
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28		
Credit points				
Studienleistung				
	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German p General Engineering Science (German p	rogram): Specialisation Bio	omedical Engineerir	ng: Compulsor
	Compulsory General Engineering Science (German p Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Me General Engineering Science (English Biomechanics: Compulsory General Engineering Science (English pr	dical Technology: Elective program): Specialisation	Compulsory Mechanical Engir	neering, Focu
Assignment for the Following Curricula	General Engineering Science (English procus Biomechanics: Compulsory General Engineering Science (English procupulsory Mechanical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation	rogram, 7 semester): Spec rogram, 7 semester): Spec Biomechanics: Compulsory Medical Technology and Con Management and B	ialisation Mechanic sialisation Biomedic / ontrol Theory: Electi usiness Administra	al Engineering al Engineering ve Compulsor ation: Electiv
	Compulsory Biomedical Engineering: Specialisation Ir Technomathematics: Specialisation III. Er	nplants and Endoprosthes	es: Elective Compu	



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



Module M1979: ME	ED I: Introduction to Radiolo	and Radiation There	IDV		
	i. introduction to Hadioic	gy and hadiation mera	ру		
Courses					
<b>Title</b> Introduction to Radiology an	d Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3	
Module Responsible					
Admission					
Requirements Recommended					
Previous Knowledge	None				
Educational Objectives	After taking part successfully, students	s have reached the following lear	ning results		
Professional Competence					
	Therapy The students can distinguish differe radiation therapy. The students can explain treatment paragery, internal medicine).				
	The students can describe the patie care.	ents' passage from their initial a	dmittance throu	gh to follow-u	
	Diagnostics				
Knowledge	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 diagno the technical basis for those techniqu		imaging techniq	ues, as well a	
	The students can choose the right tr needs.	eatment method depending on t	the patient's clini	cal history and	
	The student can explain the influence	of technical errors on the imagin	g techniques.		
	The student can draw the right con protocol.	clusions based on the images'	diagnostic findin	gs or the erro	
	<b>Therapy</b> The students can distinguish curativ conclusion.	e and palliative situations and r	motivate why the	y came to tha	
	The students can develop adequate t	herapy concepts and relate it to th	ne radiation biolo	gical aspects.	
	The students can use the therapeutic	principle (effects vs adverse effects	ets)		
Skills	The students can distinguish different situation (location of the tumor) and cl			-	
	The student can assess what an in treatment, sports, social help groups,				
	Diagnostics				
	The students can suggest solutions analyses.	for repairs of imaging instrume	ntation after hav	ring done erro	
	The students can classify results of based on their knowledge of anatomy		_	ps of disease	
Personal Competence					
	The students can assess the specia	al social situation of tumor patie	nts and interact	with them in	
Social Competence	professional way. The students are aware of the spe	cial, often fear-dominated beha	vior of sick peo	ple caused b	
·	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	,	- 3.1. <b>F</b> 00		



	diagnostic and therapeutic measures and can meet them appropriately.
	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.
Autonomy	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves.
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Credit points	3
Studienleistung	None
Examination	Written exam
Examination duration and scale	190 minutes
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General 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



	Lecture		
Hrs/wk	<u></u>		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Ulrich Carl, Prof. Thomas Vestring		
Language	DE SoSe		
	The students will be given an understanding of the technological possibilities in the field medical imaging, interventional radiology and radiation therapy/radiation oncology. It assumed, that students in the beginning of the course have heard the word "X-ray" at best will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) a		
Literature	<ul> <li>"Technik der medizinischen Radiologie" von T. + J. Laubenberg – 7. Auflage – Deutscher Ärzteverlag – erschienen 1999</li> <li>"Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – 4. Auflage - Verlag Urban &amp; Fischer – erschienen 02.03.2006</li> <li>ISBN: 978-3-437-23960-1</li> <li>"Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban &amp; Schwarzenberg – erschien 08.12.2009</li> <li>ISBN: 978-3-437-47501-6</li> <li>"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulu 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012</li> <li>ISBN: 978-3-13-567708-8</li> <li>"Der Körper des Menschen " von A. Faller u. M. Schünke - 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012</li> <li>ISBN: 978-3-13-329716-5</li> </ul>		



Courses					
Title			Тур	Hrs/wk	СР
Embodiment Design and 3D-	-CAD (L0268)		Lecture	2	1
Mechanical Design Project I	(L0695)		Project-/problem-based Learning	3	2
Mechanical Design Project II	(L0592)		Project-/problem-based Learning	3	2
Team Project Design Method	dology (L0267)		Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge	<ul> <li>Mechanics</li> </ul>	f Mechanical Engineering of Materials Science neering	Design		
Educational Objectives	After taking part success	sfully, students have reach	ed the following learning	results	
Professional Competence					
-	After passing the module	e, students are able to:			
Knowledge	<ul> <li>explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements,</li> <li>describe basics of 3D CAD,</li> <li>explain basics methods of engineering designing.</li> </ul>				
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					
	After passing the module	e, students are able to:			
Social Competence	<ul> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> </ul>				
	Students are able				
Autonomy	to estimate their level of knowledge using activating methods within the lectures (e.g. with				
Workload in Hours	Independent Study Time	e 40, Study Time in Lecture	e 140		
Credit points		·			
Studienleistung	Compulsory Bonus Yes None Yes None Yes None Yes None Yes None	Form Written elaboration Written elaboration Written elaboration Written elaboration	Description		
Examination	Written exam				
Examination duration					



and scale	180
	General Engineering Science (German program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Energy and Environmental
Following Curricula	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	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
	navai Architecture. Core quanification. Compuisory

ourse L0268: Embodim	nent 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	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system         <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>		
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K. Springer-Verlag, aktuelle Auflage.</li> <li>Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H. Hesser, W; Cornelsen, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>		



Course L0695: Mechanical Design Project I			
Тур	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	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts</li> <li>(bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>		
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>		

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



ourse L0267: Team Project Design Methodology			
Typ 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	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



Courses				
Title Numerical Mathematics I (Lo	•	Typ Lecture Recitation Section (sn	Hrs/wk 2 nall) 2	<b>CP</b> 3 3
Module Responsible	Prof. Sabine Le Borne	`	,	
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Students (german or english) or Analysis &amp; Linear Algebra I + II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>			
Educational Objectives	After taking part successfully, students have	reached the following lear	ning results	
Professional Competence				
Knowledge	<ul> <li>• name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,</li> <li>• repeat convergence statements for the numerical methods,</li> <li>• explain aspects for the practical execution of numerical methods with respect to computational and storage complexity.</li> </ul>			
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				
Social Competence	<ul> <li>work together in heterogeneously composed teams (i.e., teams from different study program and background knowledge), explain theoretical foundations and support each other wit practical aspects regarding the implementation of algorithms.</li> </ul>			
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.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	<del></del>			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	190 minutes			
	General Engineering Science (German prog General Engineering Science (German p Biomechanics: Compulsory General Engineering Science (German p Materials in Engineering Sciences: Compuls General Engineering Science (German prog General Engineering Science (German p Compulsory	rogram): Specialisation Marogram): Specialisation Masory  (ram): Specialisation Biometrics  (ram): Specialis	lechanical Eng lechanical Eng edical Engineer	ineering, Focu ineering, Focu ing: Compulsor

Focus Biomechanics: 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 Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: 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,

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

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory



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



eat Transfer (L0458) eat Transfer (L0459)					
, ,		Т	·ур	Hrs/wk	СР
, ,			ecture lecitation Section (large)	3 2	4 2
Module Responsible	Dr. Andreas Moschallski				
Admission Requirements	None				
Recommended Previous Knowledge	Technical Thermodynamics I, II and	d Fluid Dynamics			
Educational Objectives	After taking part successfully, stude	ents have reached	I the following learning	g results	
Professional Competence					
	The students are able to				
	- describe the different physical me	echanism of Heat	Transfer,		
Knowledge	- explain the technical terms,				
	- to analyse comlex heat transfer p	rocesses in a critic	cal way.		
	The students are able to				
	- understand the physics of Heat T	ransfer,			
Skills	- calculate and evaluate complex Heat Transfer processes,				
	- solve excersises self-consistent a	and in small group	S.		
Personal Competence					
Social Competence	The students are able to discuss in	n small groups and	d develop an approach	١.	
	The students are able to develop critical way. A qualified exchange			nd analyse	the results
Workload in Hours	Independent Study Time 110, Stud	dv Time in Lecture	70		
Credit points	ļ <del></del>	.,			
Studienleistung					
Examination	Written exam				
Examination duration and scale	120 min				
	General Engineering Science (G Biomechanics: Compulsory General Engineering Science (G Energy Systems: Compulsory General Engineering Science (Gel General Engineering Science (Gel Theoretical Mechanical Engineering General Engineering Science (Gel Focus Energy Systems: Compulso General Engineering Science (Gel Focus Theoretical Mechanical Engineering	German program): Sparman program): Sparman program): German program, 7 sparman program, 7	: Specialisation Mechanicalisation Biomedic : Specialisation Mechanicalisation Mechanicalisation Specialisation Semester): Specialisations	nanical Enginal Enginanical Enginanical Enginanical Enginanican Mechanican Mechanican Mechanican Mechanican Mechanican	neering, Fong: Computence in the computer in t
	General Engineering Science (Ge	rman program, 7 s	semester): Specialisati	on Biomedic	al Enginee
Assignment for the	Compulsory General Engineering Science (Eng	glish program): Sp	ecialisation Biomedica	al Engineerir	ng: Compul:
Following Curricula	General Engineering Science (E Biomechanics: Compulsory	English program):	Specialisation Mech	nanical Engi	neering, Fo
	General Engineering Science (E Energy Systems: Compulsory	ingusu program):	. opecialisation Mecr	ıanıcan Engi	neemig, F
	General Engineering Science (E	English program):	Specialisation Mech	anical Engi	neering, Fo



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

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

Course L0459: Heat Transfer		
Тур	Recitation Section (large)	
Hrs/wk	2	
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	



Courses				
Measurement Technology for	nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118)	Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Dr. Sven Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	Students are able to name the most in (Quantities and Units, Uncertainty, Calibra Systems).	ation, Static and Dynamic	Properties of	of Sensors an
Knowledge	They can outline the most important me maesured (Electrical Quantities, Temperatu	=		•
	They can describe important methods of Chromatography)	f chemical Analysis (Gas Se	ensors, Spe	ectroscopy, Ga
Skills	Students can select suitable measuring measurement devices in practice.  The students are able to orally explain iss solution approaches as well as place the iss	ues in the subject area of me	easurement	technology ar
Personal Competence  Social Competence	Students can arrive at work results in groups	s and document them in a comm	mon report.	
Autonomy	Students are able to familiarize themselves	with new measurement techno	logies.	
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	Compulsory Bonus Form  Yes None Subject theo practical work	<b>Description</b> retical and		
Examination	Written exam			
Examination duration and scale	105 minutes			
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	n program): Specialisation gram): Specialisation Biomedic gram): Specialisation Process E program, 7 semester): S gram, 7 semester): Specialisation	Mechanica al Engineering Engineering pecialisation on Mechanic	Il Engineering: Compulsor Compulsory Can Energy an



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

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



T	Dractical Course
	Practical Course
Hrs/wk	
<u>CP</u>	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
Cycle	WiSe/SoSe
	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used.
Content	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will 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	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmit Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 E 2455 Bl.1</li> </ul>
	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verl Heidelberg, 1984</li> </ul>
	<ul> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989</li> <li>Versuch 4:</li> </ul>



avT	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
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
0	2.6 Data Transmission
Content	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 fro the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Sprin 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 93486217940.



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	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses						
litle				Тур	Hrs/wk	СР
Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)				Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert	Werner				
Admission Requirements	None					
Recommended Previous Knowledge		on of signals and	systems in time an	d frequency domain, Lap	lace transfor	m
Educational Objectives	After taking pa	art successfully, s	tudents have reach	ned the following learning	g results	
Professional Competence						
Knowledge	particuter They of terms They of They	ular explain proper can explain the conferency responsion explain the Nican explain the rocan explain the can explain the conse	erties of first and se dynamics of simpl onse and root locu yquist stability crite le of the phase ma way a PID contro	behavior in time and fre cond order systems e control loops and inte s rion and the stability mar rgin in analysis and synt ller affects a control loo ontrollers designed in o	erpret dynam gins derived nesis of cont op in terms	from it. rol loops of its frequen
Skills	vice ve They c They c They c They freque They and us	ersa can simulate and can design PID co can analyze an ency response tec can calculate dis se it for digital imp	assess the behavior ontrollers with the hid synthesize simphiques screte-time approx blementation	dynamic systems from tire or of systems and control elp of heuristic (Ziegler-Pole control loops with the timations of controllers of the Control Toolbox, Sire	loops Nichols) tuning he help of lesigned in	ng rules root locus ar continuous-tin
Personal Competence						
Social Competence	Students can their controlle	_	roups to jointly so	lve technical problems,	and experim	nentally valida
Autonomy	Students can experiment gr	obtain informatuides) and use it v	when solving giver	d sources (lecture note problems. he tests and thereby conti		
Workload in Hours	Independent	Study Time 124	Study Time in Lecti	ure 56		
Credit points	l	Judy 11110 124, 0	Judy Time in Lecti			
Studienleistung						
	Written exam					
Examination duration and scale						



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

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

# Assignment for the General Englowing Curricula 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: Compulsory

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: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	
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 design of PID controllers  Frequency response techniques
	Software tools
	<ul> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	ourse L0655: Introduction to Control Systems		
Тур	Typ 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		



Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry	and Molecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, students	s have reached the following by	earning results	
Professional Competence		<u>g</u>		
Knowledge	<ul> <li>describe basic biomolecules;</li> <li>explain how genetic informatio</li> <li>explain the connection between</li> </ul>			
Skills	recognize the importance of m     describe selected molecular-d     explain the relevance of these	iagnostic procedures;		
Personal Competence				
Social Competence	The students can participate in discus	sions in research and medicir	ne on a technical lev	rel.
Autonomy	The students can develop understathemselves.	nding of topics from the cou	urse, using technica	al literature, b
Workload in Hours	Independent Study Time 62, Study Time	ne in Lecture 28		
Credit points	3			
Studienleistung				
	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	General Engineering Science (Germa Biomechanics: Compulsory General Engineering Science (Germa General Engineering Science (Germa Compulsory General Engineering Science (Germa Compulsory General Engineering Science (Germa Focus Biomechanics: Compulsory Electrical Engineering: Specialisation General Engineering Science (Englis Biomechanics: Compulsory General Engineering Science (Englis General Engineering Science (Englis Focus Biomechanics: Compulsory General Engineering Science (Englis Focus Biomechanics: Compulsory General Engineering: Specialisati Biomedical Engineering: Specialisati Biomedical Engineering: Specialisati Compulsory Biomedical Engineering: Specialisati Biomedical Engineering: Specialisati Biomedical Engineering: Specialisation	an program): Specialisation Binan program, 7 semester): Special program, 7 semester): Special program, 7 semester): Special program): Special program): Special program, 7 semester): Spec	omedical Engineerincialisation Biomedical Engineerincialisation Mechanical Engineerincialisation Mechanical Engineerincialisation Mechanical Engineerincialisation Biomedical Engineerincia Engineerincia Engineerincia Engineerincia Engineerincia Engineerinc	ng: Compulsor al Engineering neering, Focung: Compulsor al Engineering al Engineering ation: Elective Compulsor ve Compulsor



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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				
	Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage			
	Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008			
Literature				



Module M1333: Blo	O I: Implants and Fracture	Healing		
Courses				
Title Implants and Fracture Heali	ng (L0376)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate Fracture Healing".	in "Introduction into Anatomie"	before attending	"Implants and
Educational Objectives	After taking part successfully, stude	ents have reached the following lea	arning results	
Professional Competence	The students can describe the	different wave how honce head	and the requirer	monts for thei
Knowledge	existence. The students can name different morphologies.	•	•	
Skills	The students can determine the forces acting within the human body under quasi-static situation under specific assumptions.			
Personal Competence				
Social Competence	The students can, in groups, solve	basic numerical modeling tasks for	r the calculation of	internal forces
Autonomy	The students can, in groups, solve	basic numerical modeling tasks for	r the calculation of	internal forces
	Independent Study Time 62, Study	Time in Lecture 28		
Credit points				
Studienleistung			_	
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (General Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering Science (Engineerial Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Sp	man program): Specialisation Biomman program, 7 semester): Specialisation Biomman program, 7 semester): Specialisation Biomnglish program): Specialisation Biomnglish program, 7 semester): Specialish	medical Engineerin alisation Mechanical alisation Biomedical alisation Biomedical Engineerin Mechanical Engiralisation Mechanical alisation Biomedical alisation Biomedical alisation Biomedical Segenerative Medical Sciences Administratives Administratives Administratives alisations and segmentatives	ng: Compulsor al Engineering g: Compulsory neering, Focus al Engineering al Engineering licine: Elective



ourse L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
Language	Prof. Michael Morlock
Cycle	
2,000	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)
Content	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
	Cookyan V. D. Outhon ädiooka Diamaakanik
	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
Literature	Nigg, B.: Biomechanics of the musculo-skeletal system
Liter at tall C	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat



Module M0829: Fo	undations of Management			
Courses				
Title  Management Tutorial (L088) Introduction to Management	•	Typ Recitation Section (large) Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	INone			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busines			
	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	describe and explain basic business supply chain management, organiza management, innovation management     explain the relevance of planning and multiple objectives and uncertainty, Finance     state basics from accounting and costing strategies etc.) and to carry out an Entreprener analyse Management goals and structure analyse organisational and staff structure.      apply methods for decision making uncertainty.	on to Marketing and Innovation on the Marketing and Management are efinitions from the field of Marketing and goals in Management are so functions as production, pution and human ressource and marketing decision making in Busines and explain some basic may be a selected controlling may be a selected contr	and the sunagement and name the procurement management management ss, esp. in sethods from ethods.  a (organizal articular, the structure of the system system system system and system system and system and system system and system	b-disciplines in most important and sourcing ent, information situations under mathematical tion, objectives y are able to
	apply basic methods from accounting,	costing and controlling to pre	defined pro	blems
Personal Competence	Students are able to			
Social Competence	<ul> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere.</li> </ul>			write a coheren
Autonomy	Students are able to  work in a team and to organize the teal to write a report on their project.	m themselves		
Workload in Hours	Independent Study Time 110, Study Time in Lo	ecture 70		
Credit points	6			
Studienleistung				
	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Assignment for the Following Curricula

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

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

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

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

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

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



Compulsory

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

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

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

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

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

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

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

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

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

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: Managen	Course L0882: Management Tutorial		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek		
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 self-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.		



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



Module M0634: Int	roduction int	o Medi	cal Technology	and Systems		
Courses						
Title Introduction into Medical Tel Introduction into Medical Tel Introduction into Medical Tel	chnology and System	ns (L0343	)	Typ Lecture Project Seminar Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 3 2 1
Module Responsible	Prof. Alexander S	chlaefer				
Admission Requirements	None					
Recommended Previous Knowledge	principles of stoc	hastics	, analysis/calculus) , R/Matlab			
Educational Objectives	After taking part s	uccessfu	ly, students have read	hed the following learning	results	
Professional Competence						
Knowledge	aided surgery, a	nd medic	•	al technology, including ins. They are able to give		•
Skills	The students are	able to ev	valuate systems and n	nedical devices in the cont	ext of clinica	l applications.
Personal Competence	<u> </u>					
Social Competence	The students des in a joint effort.	cribe a p	roblem in medical tec	hnology as a project, and	define tasks	that are solved
Autonomy	The students can results in an appr			cument the results of their	work. They	can present the
Workload in Hours	Independent Stud	dy Time 1	10, Study Time in Lec	ture 70		
Credit points	6					
Studienleistung	Yes 10 9	%	Form Presentation Written elaboration	Description		
Examination	Written exam					
Examination duration and scale	90 minutes					
Assignment for the Following Curricula	General Engineer Compulsory Computer Science Electrical Engineer General Engineer General Engineer Compulsory Computational Science Computational Science Computational Science Compulsory Biomedical Engineer Compulsory Biomedical Engineer Biomedical Engineer Compulsory	e: Special ering: Coloring Scienting Science and cience	lisation Computer and re qualification: Electivate (English program) ince (English program) de Engineering: Special Engineering: Special Engineering: Special Specialisation Artification Engineering Implants specialisation Medical	2): Specialisation Biomedically, 7 semester): Specialisation, 7 semester): Specialisation Biomedically (Compulsory): Specialisation Biomedically, 7 semester): Specialisation, 7 semester): Specialisation Engineering Scientialisation Computer Science alisation Mathematics & Erroial Organs and Regential Computer Science and Endoprostheses: Electonology and Control Thagement and Business	ective Company on Biomedia on	cal Engineering culsory ng: Compulsory cal Engineering re Compulsory compulsory cience: Elective dicine: Elective ulsory ive Compulsory



Course L0342: Introduct	ion into 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	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>
Literature	Wird in der Veranstaltung bekannt gegeben.

Course L0343: Introduct	ourse 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: Introduct	Course L1876: Introduction into 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		
Content	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>		
Literature	Wird in der Veranstaltung bekannt gegeben.		



Module M1280: ME	ED II: Introduction to Physiology	у		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Physiology (I	_0385)	Lecture	2	3
Module Responsible	Dr. Roger Zimmermann			
Admission	None			
Requirements Recommended				
Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following le	earning results	
Professional Competence				
•	The students can			
Knowledge	<ul> <li>describe the basics of the energy m</li> <li>describe physiological relations in sensory physiology.</li> </ul>		scle, heart/circulation	on, neuro- and
Skills	The students can describe the effects of barrier of information, development of forces and was a state of the control of the c			
Personal Competence				
Social Competence	The students can conduct discussions in re The students can find solutions to problem:			d metrological.
Autonomy	The students can derive answers to quest using technical literature, by themselves.	stions arising in the cou	rse and other phys	iological areas
Workload in Hours	Independent Study Time 62, Study Time in	Lecture 28		
Credit points	3			
Studienleistung				
	Written exam			
Examination duration and scale	60 minutes			
_	General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Med General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro Compulsory Mechanical Engineering: Specialisation Bi Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Im Technomathematics: Core qualification: Electronomathematics: Specialisation III. Engineering: Specialisation IIII.	ogram): Specialisation Bio ogram, 7 semester): Specialisation, 7 semester): Specialisation ical Technology: Elective program): Specialisation Bio ogram, 7 semester): Speciali	comedical Engineering cialisation Biomedical Engineering compulsory and Mechanical Engineering cialisation Mechanical Engineering cialisation Mechanical Engineering cialisation Biomedical Engineering cialisation Biomedical Engineering Control Theory: Elective Engineering Elective Engineering Elective Engineering Elective Elec	ng: Compulsory cal Engineering neering, Focus ng: Compulsory cal Engineering cal Engineering cal Engineering cal Engineering dive Compulsory ation: Elective



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



Module M1332: Blo	O I: Experimental Method	s in Biomechanics		
Courses				
<b>Title</b> Experimental Methods in Bio	mechanics (L0377)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate i Methoden".	n "Implantate und Frakturheilung"	before attending '	'Experimentelle
Educational Objectives	After taking part successfully, stude	ents have reached the following lea	arning results	
Professional Competence		different ways how bones heal,	and the require	ments for thei
Knowledge	morphologies.	treatments for the spine and hole		
Skills	the adequate technique for a giver The students can describe the biomechanics.	n task. e basic handling of several exp	perimental techn	iques used ir
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			
Studienleistung	None			
	Written exam			
Examination duration and scale	90 min			
_	Biomechanics: Compulsory General Engineering Science (Ge Focus Biomechanics: Compulsory General Engineering Science (Ge Focus Biomechanics: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Eng General Engineering Science (Eng Biomechanics: Compulsory General Engineering Science (Eng Focus Biomechanics: Compulsory General Engineering Science (Eng Focus Biomechanics: Compulsory General Engineering Science (Eng Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Specialis	rman program, 7 semester): Special glish program): Specialisation Biomenglish program): Specialisation glish program, 7 semester): Special glish program, 7 semester): Special glish program, 7 semester): Special	nedical Engineerinalisation Mechanical Engineerinalisation Biomedical Engineerinalisation Mechanical Engineerinalisation Mechanical Engineerinalisation Biomedicalisation Biom	ng: Compulsory al Engineering ag: Compulsory neering, Focus al Engineering al Engineering dicine: Elective Isory ve Compulsory



Course L0377: Experime	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.

Module M0833: Int	roduction to Control System	s		
Courses				
Title Introduction to Control Syste	ems (L0654)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
Introduction to Control Syste	ems (L0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems	in time and frequency domain, Lapla	ace transfor	m
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequenc response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	vice versa  They can simulate and assess the They can design PID controllers  They can analyze and synthe frequency response techniques  They can calculate discrete-time and use it for digital implementa	of linear dynamic systems from time behavior of systems and control le with the help of heuristic (Ziegler-Niesize simple control loops with the approximations of controllers detion tools (Matlab Control Toolbox, Similar	oops ichols) tuning e help of esigned in	ng rules root locus and continuous-time
Personal Competence				
Social Competence	Students can work in small groups to their controller designs	jointly solve technical problems, a	nd experim	entally validate
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it 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 Tin	ne in Lecture 56		
Credit points	6			
	1			



Studienleistung Examination	None Written exam
Examination duration and scale	120 min
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus 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 Engrapy Systems Compulsory
	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
Assignment for the	
Following Curricula	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: Compulsory

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



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



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: Co	omputer Engineer	ing			
Courses					
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032			Typ Lecture Recitation Section (s	Hrs/wk 3 mall) 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge					
<b>Educational Objectives</b>	After taking part succes	sfully, students have	reached the following lea	rning results	
Professional Competence					
Knowledge	<ul> <li>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:         <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses</li> </ul> </li> </ul>				
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the interr structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple componer. They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors.  After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they shounderstand the consequences that the execution of software has on the hardware-centric abstractillayers 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.			nalyze, how highly mple components layers of today' nterdependencie ticular, they sha centric abstractioned to evaluate the	
Personal Competence					
Social Competence	Students are able to sol	lve similar problems	alone or in a group and to	present the re	sults 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 Tim	e 124, Study Time in	Lecture 56		
Credit points	6				
Studienleistung	Compulsory Bonus Yes 10 %	Form Excercises	Description	on	



Examination duration and scale	90 minutes, contents of course and labs
una odalo	General Engineering Science (German program): Core qualification: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and
	Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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
Following Curricula	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: 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: Compute	er 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	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>

Course L0324: Computer 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 M0820 · Fo	undations of Management			
	undations of Management			
Courses				
Title	0)	Typ	Hrs/wk	CP
Management Tutorial (L088: Introduction to Management		Recitation Section (large) Lecture	2	3 3
Module Responsible	Prof. Christoph lhl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busine	ess		
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry 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 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  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a coherence 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 I	Lecture 70		
Credit points				
Studienleistung	None			
Examination	Subject theoretical and practical work			
Examination duration				



#### and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Assignment for the Following Curricula

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

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

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

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

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

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



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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 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 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			
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek		
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 self-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.		



irse LU88U: Introduct	ion to Management				
	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 rischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona				
Language	DE				
Cycle	WiSe/SoSe				
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>				
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.  Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.  Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.  Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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 M0854: Ma	athematics IV			
Courses				
Title		Tun	Hrs/wk	СР
	tial Differential Equations) (L1043)	<b>Typ</b> Lecture	Hrs/wk 2	1
•	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible  Admission				
Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional				
Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperating</li> </ul>			
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Studienleistung				
	Written exam			
Examination duration				
and scale	60 min (Complex Functions) + 60 min (Diff	erential Equations 2)		
	I			



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

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

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

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

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

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

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

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

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

# Assignment for the Following Curricula

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

Theoretical Mechanical Engineering: Compulsory

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

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

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

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

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory 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	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  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	

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			
Content	Main features of complex analysis  Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation			
Literature	http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html			

Course L1041: Complex Functions		
Тур	Recitation Section (small)	
Hrs/wk	1	
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:	Mechanics	IV (Kinetics	II,	Oscillations,	Analytical	Mechanics,	Multibody
Systems)							

Courses						
Title	Oppillation - Accel de Late	abanias AA 69 1	Тур	Hrs/wk	СР	
Mechanics IV (Kinetics II, (L1137)				3	3	
Mechanics IV (Kinetics II, (L1138)	Oscillations, Analytical Med	chanics, Multibody	Systems) Recitation Section	n (small) 2	2	
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Med	chanics, Multibody	Systems) Recitation Section	n (large) 1	1	
Module Responsible	Prof. Robert Seifried					
Admission Requirements	None					
Recommended Previous Knowledge	Mathematics I-III and Me	echanics I-III				
Educational Objectives	After taking part success	sfully, students ha	ve reached the following	learning results		
Professional Competence						
	The students can					
Knowledge	<ul><li>describe the axio</li><li>explain importan</li><li>present technica</li></ul>	it steps in model o	used in mechanical conte design;	exts;		
	  The students can					
Skills	and apply it to th  apply basic meth	e context of their nods to engineeri		•		
Personal Competence Social Competence	<del>-</del>	n groups and sup	port each other to overco	me difficulties.		
Autonomy	· ·	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.				
Workload in Hours	Independent Study Time	e 96, Study Time	n Lecture 84			
Credit points	6					
Studienleistung	No 20 %	<b>Form</b> Midterm	<b>Descrip</b> Wird nu	<b>otion</b> r im SoSe angebot	ten	
Examination	Written exam					
Examination duration and scale	1120 min					
	General Engineering So General Engineering So Compulsory General Engineering So Compulsory General Engineering So Compulsory General Engineering So	cience (German p cience (German p cience (German p Science (German cience (English p	nan program): Special rogram): Specialisation B rogram): Specialisation N rogram, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 8 specialisation, 9 spe	iomedical Enginee aval Architecture: ( cialisation Mechan cialisation Biomed Specialisation Na echanical Enginee	ering: Compulsory Compulsory nical Engineering: lical Engineering: aval Architecture: ring: Compulsory	



Assignment for the	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Technomathematics: Core qualification: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory

Course L1137: Mechanic	cs 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	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> <li>Numerical methods for time integration</li> <li>Introduction to Matlab</li> </ul>
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	



Courses				
Title		Тур	Hrs/wk	CP
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Lecture Recitation Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous Knowledge	Sound knowledge of engineering mathemat	ics, engineering mechanics an	d thermodyr	namics.
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	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 prediction of fluid engineering devices.			
Skills	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 calculation for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence	The students are able to discuss problems a	nd jointly develop solution stra	tegies	
Social Competence	p. 62.16.110 a	,	.09.00.	
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crticall analyse results.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the 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): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture 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, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory			



Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0454: Fluid Mechanics		
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	<ul> <li>Overview</li> <li>Physical/mathematical modelling</li> <li>Special phenomena</li> <li>Basic equations of fluid dynamics</li> <li>The turbulence problem</li> <li>One dimensional theory for inkompressibel flows</li> <li>One dimensional theory for kompressibel flows</li> <li>Flow over contours without friction</li> <li>Flow over contours with friction</li> <li>Flow through channels</li> <li>Simplified equations for three dimensional flow</li> <li>Special aspects of the numerical solution for complex flows</li> </ul>	
Literature	<ul> <li>Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006</li> <li>Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004</li> </ul>	

Course L0455: Fluid Mechanics	
Тур	Recitation Section (large)
Hrs/wk	2
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: Sto	ochastics and Ship Dynamics			
Courses				
Title Ship Dynamics (L0352) Ship Dynamics (L1620) Statistics and Stochastic P	<b>Typ</b> Lecture Recitation Processes in Naval Architecure and Ocean Engineering Lecture	on Section (small)	Hrs/wk 2 1 2	<b>CP</b> 3 1
(LU364)				
<del>-</del>	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	INone			
Recommended Previous Knowledge	I inear algebra analysis compley numbers			
<b>Educational Objectives</b>	After taking part successfully, students have reached the fo	ollowing learning r	esults	
Professional				
Competence	  - The students are able to give an overview over variou	is manoelivros Ti	hev can nor	me annlication
Knowledge	goals and they can describe the procedure of the manoeuvres.  - The students are able to give an overview over varius rudder types. They can name criteria in the rudder design.  - The students can name computation methods which are used to determine forces and motions in waves.			
	- The students can come up with the equations of motions can use and linearise them.  - The students are able to determine hydrodynamic coemeaning.			
Skills	The students can explain how a rudder works and they	$\prime$ can explain the $ $	physical effe	ects which car
	- The students can mathematically describe waves.			
	- The students can explain the mathematically descriptio can determine them.	n of harmoncial n	notions in w	aves and the
Personal Competence				
·	- The students can arrive at work results in groups and doc	cument them.		
Social Competence	- The students can discuss in groups and explain their poi	nt of view.		
Autonomy	- The students can assess their own strengthes and weak this basis.	nesses and the de	efine further	work steps or
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	118() min			
	General Engineering Science (German program): Speciali General Engineering Science (German program, 7 se Compulsory			



Assignment for the General Engineering Science (English program): Specialisation Naval Architecture: Compulsory Following Curricula General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Moustafa Abdel-Maksoud
Language	
Cycle	
	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	<ul> <li>Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik uschiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and S Theory, Hamburg University of Technology, 2014</li> <li>Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre Hous Jordan Hill, Oxford, United Kingdom, 2000</li> <li>Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley &amp; Sons, Canada,1978</li> <li>Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993</li> <li>Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Be Heidelberg, Deutschland, 1992</li> <li>Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Pre United Kingdom, 1990</li> <li>Handbuch der Werften, Deutschland, 1986</li> <li>Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001</li> <li>Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllabil Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989</li> <li>Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, Wo Scientific, USA, 2004</li> <li>Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998</li> </ul>



Course L1620: Ship Dyn	ourse 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	

ırse L0364: Statistic	s 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	<ul> <li>descriptive statistics, parameter, criteria for outliers</li> <li>sample, sample space, probability, probability space</li> <li>Bayes method, conditional probability, law of total probability</li> <li>Discrete and continuous random variables</li> <li>Probability distributions</li> <li>mixed and joint random variables and their distribution</li> <li>Characteristics of random variables (expectation, variance, skewness, kurtosis,)</li> <li>(central) limit theorem</li> <li>Stochastic processes</li> <li>Statistical description of seaway, harmonic analysis of seaway</li> <li>narrow-banded Gaussian process, seaway and its characteristics</li> <li>sea- and wind spectra</li> <li>transformation of spectra, transfer function</li> </ul>	
Literature	<ul> <li>V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001</li> <li>H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3<sup>rd</sup> Edition John Wiley &amp; Sons, Inc., New York, NY, 2009</li> <li>ITTC Becommended Procedures and Guidelines. In: Quality Systems Manual. International Towing</li> </ul>	



Module M0655: Co	omputational Fluid Dynamic	s I		
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynami Computational Fluid Dynami		Lecture Recitation Section (large)	2	3
Module Responsible		( . 3 . ,		-
Admission Requirements				
Recommended Previous Knowledge		gineers ntegral calculus and series expansio	ons	
Educational Objectives	After taking part successfully, students	s have reached the following learning	g results	
Professional Competence				
Knowledge	The students are able to list the basic	numerics of partial differential equa	tions.	
Skills	The students are able develop appropriate numerical integration in space and time for the governing partial differential equations. They can code computational algorithms in a structured way.			
Personal Competence  Social Competence  Autonomy	The students can arrive at work result  The students can independently analy		roblems.	
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points		III LOOKATO OO		
Studienleistung				
	Written exam			
Examination duration and scale	2h			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, For Energy Systems: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory		ompulsory val Architecture cal Engineering ompulsory ineering, Focu val Architecture	



Course L0235: Computa	tional 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: Computa	ourse L0419: Computational Fluid Dynamics I	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



wodule MU659: Fu	ndamentals of Ship Structural Desi	gn and Analysis		
Courses				
Title  Fundamentals of Ship Structural Design (L0411)  Fundamentals of Ship Structural Design (L0413)  Fundamentals of Ship Structural Analysis (L0410)		Typ Lecture Recitation Section (small) Lecture	Hrs/wk 2 1 2	<b>CP</b> 2 2 2
Fundamentals of Ship Struc		Recitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III			
<b>Educational Objectives</b>	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
	Students can reproduce the basic contents of the structural behaviour of ship structures; they can explain the theory and methods for the calculation of deformations and stresses in beam-like structures.  Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished product			s in beam-like
Skills	joining and principles of structural design of components in the ship structure.  Students are capable of applying the methods and tools for the calculation of linear deformations ar stresses in the above mentioned structures; they can choose calculation models of typical sh 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.		of typical shi	
Personal Competence  Social Competence	The students are able to communicate and shipbuilding and component supply industry.	cooperate in a profess	sional envir	onment in th
Autonomy	The students are capable to independently idealize real ship structures and to select suitable method for analysis of beam-like structures; they are capable to assess the results of structural analyses.  Furthermore, they are capable to assess drawings of complex ship structures and to design ship structures for various requirements and boundary conditions.			
Workload in Hours	Independent Study Time 156, Study Time in Lect	 ure 84		
Credit points				
Studienleistung				
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the	General Engineering Science (German program General Engineering Science (German progra Compulsory General Engineering Science (English program)	am, 7 semester): Special	isation Nav	al Architecture



Following Curricula General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
Naval Architecture: Core qualification: Compulsory

Course L0411: Fundame	urse 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 of Ship Structural Design	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Chapters:  1. Introduction  3. Class societies and their tasks  4. Materials for steel shipbuilding  5. Welding and Cutting  6. Semi-finished products in steel shipbuilding  7. Determining the scantlings for local loads  8. Longitudinal strength of the hull girder  9. Determining the scantlings of longitudinal structural members  10. Determining the scantlings of bottom and side structures  11. Decks and Hatch Openings  12. Effective breadth  13. Iterative determination of scantlings (POSEIDON)
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht



Course L0410: Fundamentals of Ship Structural Analysis	
Тур	Lecture
Hrs/wk	2
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 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente

Course L0414: Fundamentals of Ship Structural Analysis	
Тур	Recitation Section (small)
Hrs/wk	1
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: Str	ructural Design and Construction	of Ships		
Courses				
Title		Тур	Hrs/wk	СР
Ship Structural Design (L041		Lecture	2	3
Ship Structural Design (L041 Welding Technology (L1123)		Recitation Section (small) Lecture	2	3 3
		Lecture		3
Module Responsible  Admission				
Requirements	None			
Recommended Previous Knowledge	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
	Students can reproduce design and sizing structures and of different ship types (incl. decomplex structures.			•
Knowledge				
	Students are capable to specify the requirement design criteria for the components, to select structure			
Personal Competence				
Social Competence	Students are capable to present their structura group.	al design and discuss their d	ecisions co	nstructively in a
	Students are capable to design independently ship types and to define appropriate fabrication		f the ship h	ull and different
Autonomy				
Workload in Hours	Independent Study Time 172, Study Time in Le	ecture 98		
Credit points	9			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula	General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (English program General Engineering Science (English prog Compulsory Naval Architecture: Core qualification: Compuls	gram, 7 semester): Specialin): Specialisation Naval Archaram, 7 semester): Speciali	sation Nav	al Architecture:



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

Course L0415: Ship Stru	ourse L0415: Ship Structural Design	
Тур	Recitation Section (small)	
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	



Course L1123: Welding	Technology	
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer	
Language		
Cycle	-	
	- 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	
Content	- 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	
	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.	
Literature	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen 3. Aufl., Berlin 2005.	
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit vor Schweißkonstruktionen, 2. Aufl., Berlin 2002.	



Module M1109: Resistance and Propulsion				
Courses				
Title		Typ	Hrs/wk	СР
Resistance and Propulsion	(I 1265)	Typ Lecture	nrs/wk 2	3
Resistance and Propulsion		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Mechanics</li><li>Fluid Dynamics for Naval Architects</li><li>Hydrostratics</li></ul>			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional		<u> </u>		
Competence				
Knowledge	The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fuel consumption. The following topics are dealt with:  - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrust deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims  The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the			
	course will enable the student to clearl determine and minimize the required power including environmental influences.			
Personal Competence		San according to the control of the		dala dala 6 950
Social Competence	suvervision team.		·	
Autonomy	The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Studienleistung				
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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



				Hamhum University of Te
Module M1118: Hy	drostatics and Body Plan			
<b>2</b>				
Courses				
Title	Тур		Hrs/wk	СР
Hydrostatics (L1260)	Lecture	Castian (large)	2	3
Hydrostatics (L1261) Body Plan (L1452)	Project Se	Section (large) eminar	2	1 2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
	Good knowledge in Mathemathics I-III and Mechanics I-III.			
Recommended Previous Knowledge	It is recommended that the students are familiar with typical GA- Plan, Tank Plan etc.	l design relevan	it drawings,	e.g. Body Plar
Educational Objectives	I			
Professional Competence				
Knowledge	The lecture enables the student to carry out all necessary the scientific level. The lecture is basic requirement for all followand safety of ships.			
Skills	The student is able to carry out hydrostatic calculations to He is able to design hull forms that are safe against capsizing		ship has su	ıfficient stabilit
Personal Competence				
Social Competence	The attendent water and a to be also at a to a local and a local a			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program): Specialis General Engineering Science (German program, 7 sem Compulsory			

Course L1260: Hydrostatics	
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	SoSe
	Numerical Integration, Diffrentation, Interpolation
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods - Determination of Areas, 1st and 2nd order Moments
	Botomination of Arous, For any End of Soft Monthly

Naval Architecture: Core qualification: Compulsory

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

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

Following Curricula



- Numerical Diffrentation, Spline Interpolation
- 2. Buyoancy
  - Principle of Archimedes
- Equlibrium Floating Condition
- Equlibrium Computations
- Hydrostatic Tables and Sounding Tables
- Trim Tables
- 3. Stability at large heeling angles
  - Stability Equation
  - Cross Curves of Stability and Righting Levers
  - Numerical and Graphical Determination of Cross Curves
  - Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
  - Heeling Moments of Different Type
  - Balance of Heeling and Righting Moments acc. to BV 1030
- Intact Stability Code (General Critaria)
- 4. Linearization of Stability Problems
- Linearization of Restoring Forces and Moments
- Correlation between Metacentric Height and Righting Lever at small heeling angles
- Computation of Path of Metacentric Height for Modern Hull Forms
- Correlation between Righting Lever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix
- Definition of MCT
- Computation of Equilibrum Floating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Initial GM
- Roll Motions at Small Roll Angles
- 6. Stability in Waves
  - Roll Motions at Large Amplitudes
  - Pure Loss of Stability on the Wave Crest
  - Principle of Parametric Excitation
- Principle of Direct Wave Moments

### Content

- 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
- 1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig
- 2. Henschke

Schiffstechnisches Handbuch, Band 1

VEB Technik Verlag Berlin

#### Literature

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



ourse 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 Pla	ın			
Тур	Project Seminar			
Hrs/wk				
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	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig  2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin  3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.			



Module M0933: Fu	ndamentals of Mater	ials Science			
2					
Courses					
Title  Fundamentals of Materials Science I (I 1095)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2	
Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers a		and Lecture			
Composites) (LU506)				2	2
Physical and Chemical Basi	cs of Materials Science (L1095)		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller				
Admission Requirements	None				
Recommended Previous Knowledge	Highschool-level physics, ch	nemistry und mathe	matics		
Educational Objectives	After taking part successfully	v, students have rea	ched the following	learning results	
Professional					
Competence					
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. 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 to the underlying physical and chemica 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 or the material's behavior.				
<b>Personal Competence</b>					
Social Competence	-				
Autonomy	-				
	Independent Study Time 96	, Study Time in Lect	ure 84		
Credit points					
Studienleistung					
	Written exam				
Examination duration and scale	180 min				
	General Engineering Science Engineering: Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science Compulsory General En	ience (German program ce (German program ce (German program ce (German program ce (German program nce (German prog	orogram): Special n): Specialisation E n): Specialisation N n, 7 semester): Spe m, 7 semester): Spe ram, 7 semester):	lisation Mechanical Biomedical Engineerin Naval Architecture: Contection Mechanic Recialisation Biomedic Specialisation Nav	I Engineering ng: Compulsor ompulsory cal Engineering cal Engineering



	Enviromental Engineering: Compulsory					
	Energy and Environmental Engineering: Core qualification: Compulsory					
	General Engineering Science (English program): Specialisation Energy and Environmental					
Following Curricula	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 Naval Architecture: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:					
	Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:					
	Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental					
	Engineering: Compulsory					
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory					
	Mechanical Engineering: Core qualification: Compulsory					
	Mechatronics: Core qualification: Compulsory					
	Naval Architecture: Core qualification: Compulsory					
	Technomathematics: Specialisation III. Engineering Science: Elective 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: Fundame	entals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider
Language	DE
Cycle	SoSe
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7



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



Module M1110: Sh	nip Design			
	, , , , , , , , , , , , , , , , , , ,			
Courses				
<b>Title</b> Ship Design (L1262) Ship Design (L1264)		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	,			
<b>Educational Objectives</b>	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	Competitive Elements of Ship Designs are thoroughly discussed. Typical bulding contracts and the related technical risk are introduced. The most important main parameters of a ship are introduced at their influence on the competitiveness of a design. The lecture focusses on the influence of alternation main parameters on the total performance of a ship design and the consecutive process elements. This lecture, the design changes are dealt with by simple models or formulae. The student shall furth learn to model complex systems properly so that the relavent technical conclusions can be drawn.  The lecture continues with an introduction into the different phases of design project, from the initial design phase to a building contract. Further, methods are introduced to generate bulding specification relevant information at different levens of granularity during the different design stages. In detail, the following topics are addressed:			
	<ul> <li>Structure of a building specification</li> <li>Determination of Light Ship Weight and Dea Components</li> <li>Design of main section and hull form</li> <li>Design of aftbody lines and manoevering de</li> <li>Design of main propulsion plant</li> <li>Design of subdivision</li> <li>Determination of limiting GMrequ- Curves</li> <li>Scantlings of most improtant structural members.</li> <li>Longitudinal strength</li> <li>Outfitting Components</li> <li>Relevant rules and regulations</li> </ul>	vices		
Skills	The student is made familiar with the basic design principles of seagoing mearchant ships. The goal of the lecture is that the student shall be able to carry out a concept design based on a vessel of comparison fulfilling typical contract requirements within the Marine Environment. The lecture deals with the basic design methods to determine the fundamantal technical characteristics of a ship design with respect to fulfillment procedures of the contract values. Based on the lecture "Principles of Ship Design" the relevant methods to determine and judge uopn the performance of a ship design are treated.			
Personal Competence				
Social Competence	The students learns to prepare technical macustomer against his competitors.	atters in such a way the he	can persua	de his potantia
Autonomy	The students learns to prepare technical macustomer against his competitors.	atters in such a way the he	can persua	de his potantia
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Studienleistung	None			
	Written exam			



Examination duration and scale	180 min
	H-anarai Enginaaring Scianca (English program). Spacialisation Navai Architactura, Lombilisary

Course L1262: Ship Design	
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	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.

Courses				
<b>Title</b> Introduction into Process Er Fundamentals of material er	gineering/Bioprocess Engineering (L0829) gineering (L0830)	<b>Typ</b> Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 1 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have	e reached the following	learning results	
Professional Competence	After passing this module the students have	e the ability to:		
Knowledge	<ul> <li>give an overview of the most important fields on process and bioprocess engineering,</li> <li>explain some working methods for different fields in process engineering.</li> </ul>			
Skills	After passing this module the students show     Itist and outline the most important firent important working engineering,     read and prepare an engineering description explain the most important technologies scheme typical chemical and bid pointers.	elds of process enginee approaches or method rawing, gies for wastewater and	ds of the different fi	ent
Personal Competence	The students are able to			
Social Competence	<ul> <li>work out results in groups and docu</li> <li>provide appropriate feedback and h</li> </ul>		r own performance c	constructively.
Autonomy	The students are able to estimate their pro of knowledge in Process Engineering and			berate their lac



Workload in Hours	Independent S	Study Time 3	4, Study Time in Lectu	re 56
Credit points	3			
Studienleistung	Compulsory E	<b>Bonus</b> None	<b>Form</b> Written elaboration	Description
Examination	Written exam			
Examination duration and scale	190 min			
•	190 min			

Course L0829: Introduct	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		
	Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering.		
Literature	s. StudIP		



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



Courses						
Title		T	ур	Hrs/wk	СР	
Physical Chemistry (L0833)			ecture	2	2	
Physical Chemistry (L0835)		Pi	ractical Course	2	1	
<u>-</u>	Prof. Hans-Ulrich Moritz					
Admission Requirements Recommended	None					
Previous Knowledge	If contante at the arevialle madules inargenic chemistry, abysics for engineers and methematics 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					
Knowledge	-to describe and summariz	the underlying concepts	of mass-, heat- ar	nd momentum tr	ansfer.	
	- to interpret phase diagrams and affiliate kinetic rate laws.					
	The students are able to					
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.					
Skills	s - assess new applications with respect to environmental sustainability.					
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kine calculations.					
Personal Competence						
The students are able to plan, prepare, conduct and document experi guidelines in small groups.		eriments accord	ling to scienti			
Social Competence	The students are able to reflect their subject-specific knowledge orally in a team and to discuss it w fellow students and faculty.					
Autonomy	Students are able to assess their knowldege continuously on their own by exemplified practic Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.					
Workload in Hours	Independent Study Time 3	Study Time in Lecture 5	6			
Credit points	3					
Otrodia o la la la	<b>Compulsory Bonus</b>	orm	Description	1		
Studienleistung	Yes None	ubject theoretical ractical work	and			
Examination	Written exam					
Examination duration and scale	180 min					
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester):					



Elective Compulsory
Process Engineering: Core qualification: Compulsory

Course L0833: Physical Chemistry				
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	r 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	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>			



Course L0	835: 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/studium/nebenfach/tuhh3/Praktikum_2013_2014.html



Courses					
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032			Typ Lecture Recitation Section (small)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge	examination according to  1. Upon a passed marks due to the respectively, up to	etion of the labs will on the following rules:  module examination as successful labs, succ	be honored during the each the student is granted a beh that the examination's map is a control of 4,3 and of 4,3 up to 4,0 is not a control.	oonus on the arks are lifte	e examination'
<b>Educational Objectives</b>	After taking part success	fully, students have re	ached the following learning	results	
Professional Competence					
Knowledge	from the assembly-level  Introduction Combinational Incombinational Incombinational Incombinational Incombinational Incombinational Incombinational Incombinational Incombination Incomb	logic: Gates, Boolean betworks Flip-flops, automata, undations etic: Integer addition, outer architecture: Properties, SRAM from the perspective sees  computer systems from the perspective sees  computers can be built of the module, imputer system and unders that the executive sees  etion of the module, imputer system and underses that the executive language down to	e functionality of computing so gates. The module includes an algebra, Boolean functions systematic hardware design subtraction, multiplication and rogramming models, MIPS of the CPU, principles of the architect's perspective, mputer systems. The student to the explain the different allow to complete processors. The students are able to just the software executed on the figates. This way, they will be on an entire system's personner.	tions, hardward division single-cyc passing data i.e., they idents can analyew and simplestraction ladge the interior it. In participardware-ceibe enabled	g topics:  vare synthesis  le architecture  a, point-to-poin  ntify the interna yze, how highly ile components yers of today's  erdependencies ular, they sha  ntric abstraction to evaluate the
Personal Competence					
Social Competence	Students are able to solv	ve similar problems al	one or in a group and to pres	sent the resu	lts accordingly.
Autonomy	Students are able to account with other classes.	quire new knowledge	from specific literature and	to associate	this knowledge
Workload in Hours	Independent Study Time	e 124, Study Time in L	ecture 56		
Credit points					
	Compulsory Bonus	Form	Description		



# **Examination duration** 90 minutes, contents of course and labs and scale General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and **Environmental Engineering: Compulsory** General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus 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 Assignment for the General Engineering Science (English program): Core qualification: Compulsory Following Curricula 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: 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: Compute	r Engineering		
Тур	Lecture		
Hrs/wk	3		
СР			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>		
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>		

Course L0324: Computer 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							
Title				Тур		Hrs/wk	СР
Fundamentals of Fluid Mech Fluid Mechanics for Proces	Lecture Recitation S	Section (large)	2 2	4 2			
Module Responsible	Prof. Michael	Schlüter					
Admission Requirements	None						
Recommended Previous Knowledge	<ul><li>Techr</li><li>Techr</li><li>Worki</li></ul>	ng with force ification and	nics I+II odynamics I+II e balances	al differential equatio	ons		
Educational Objectives	After taking p	art successf	ully, students ha	eve reached the follo	wing learning	results	
Professional Competence							
Knowledge	<ul><li>give a engin</li><li>explain</li></ul>	in the differe an overview eering	of for different a	fferent types of flow pplications of the I Continuity- and Na		•	·
Skills	<ul><li>reduc</li><li>solution</li><li>notice</li></ul>	ibe and mode e the gover ons e.g. by it e the depend	ning equations ntegration lency between t	ole flows mathemation of fluid mechanics theory and technical application	by simplificat applications		
Personal Competence							
Social Competence	inform • able t result • are at	apable to ganation to the owork toges seffectively	context of the lead ther on subject in English (e.g. out solutions for	from subject related ecture and related tasks in sm during small group of exercises by themse	all groups. Th exercises)	ey are able	to present the
Autonomy		h further lite		opic and to expand t wn and to evaluate t	_		
Workload in Hours	Independent	Study Time	124, Study Time	e in Lecture 56			
Credit points	6						
Studienleistung	Compulsory Yes	Bonus 5%	<b>Form</b> Midterm	D	escription		
Examination	Written exam						
Examination duration and scale	2 hours						



General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and **Environmental Engineering: Compulsory** Bioprocess Engineering: Core qualification: Compulsory Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (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 Process Engineering: Core qualification: Compulsory

ırse L0091: Fundame	entals of Fluid Mechanics		
	Lecture		
Hrs/wk			
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle			
Content	<ul> <li>fluid properties</li> <li>hydrostatic</li> <li>overall balances - theory of streamline</li> <li>overall balances- conservation equations</li> <li>differential balances - Navier Stokes equations</li> <li>irrotational flows - Potenzialströmungen</li> <li>flow around bodies - theory of physical similarity</li> <li>turbulent flows</li> <li>compressible flows</li> </ul>		
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluide Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994.</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematisch Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006.</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömunge Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008.</li> <li>Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethode Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009.</li> <li>Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007.</li> <li>Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgäng dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008.</li> <li>Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006.</li> <li>van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.</li> <li>White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-007131121.</li> </ol>		



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



Courses				
<b>Title</b> Phase Equilibria Thermodyn Phase Equilibria Thermodyn Phase Equilibria Thermodyn	namics (L0140)	Typ Lecture Recitation Section (smal Recitation Section (large	•	<b>CP</b> 2 2 2
Module Responsible	` ',	(	,	
Admission Requirements	LINANA			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermo	dynamics I and II		
<b>Educational Objectives</b>	After taking part successfully, students ha	ve reached the following learning	ng results	
Professional Competence	<ul> <li>Starting from the very basics of the describe thermodynamic equilibria</li> </ul>	<b>1</b> .		
Knowledge	<ul> <li>They learn how state variables are influenced by the mixing of compounds and learn concept to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibriar Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes a shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	<ul> <li>Applying their knowledge, the sequestermination of the equilibrium st</li> <li>The students know models which equilibrium state and they are ableed.</li> <li>For specific applications, they approperties of compounds as well are Beside pure compound properties mixtures.</li> <li>The students know how to visu interpret the occurring phenomena.</li> <li>Based on their knowledge, the stuthe basis for many separation and</li> </ul>	ate and know how to simplify the can be used to determine the part to solve the resulting mathematic able to self-reliantly find a model parameters in literatures the students are capable of alize phase equilibria graphical.	ese equations properties of the atical relations necessary per sources. If describing the cally and the aundamental compared to the cally and the cally and the aundamental compared to the properties of the cally and the aundamental compared to the properties of the cally and the aundamental compared to the cally and the ca	s meaningfully, the system in the system in the state of the system in the system in the system in the properties by know how the system in th
Personal Competence	The students are able to work in small o	roups, to solve the correspond	lina problems	s and to prese
Social Competence	them oraly to the tutors and other students		3 p. 23.0.110	p. 000
Autonomy	<ul> <li>The students are able to find ned judge their quality.</li> <li>During the semester the students exercises. Based on this knowledge</li> </ul>	s are able to check their learn	ing progress	continuously
Workload in Hours				



Credit points Studienleistung	Rone
Examination	Written exam
Examination duration and scale	I 120 minutes: ineoretical questions and calculations
•	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory

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



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



Course L0142: Phase Ed	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	<ol> <li>Introduction: Applications of thermodynamics of mixtures</li> <li>Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity</li> <li>Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule</li> <li>Equations of state: virial equations, van-der-Waals equation, generalized equations of state</li> <li>Mixing properties: ideal and real mixtures, excess properties, partial molar properties</li> <li>Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition</li> <li>Gas-liquid-equilibria: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: equilibrium condition, binary systems</li> <li>Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>				
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>				



Madala Moczo Ob				
Module M0672: Sig	gnals and Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (small)	3 2	4 2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements				
noquii omonio	Mathematics 1-3			
	The modul is an introduction to the theory of covered by the moduls Mathematik 1-3 is exp (Fourier series, Fourier transform, Laplace tran	ected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describ methods of signal and system theory. They continuous-time and discrete-time signals and signals and systems mathematically in both tin effects in time domain and image domain whisignal to a discrete-time signal.	are able to apply the funda systems. They can describe ne and image domain. In par nich are caused by the tran	amental trailed amalysticular, they sition of a continuous	nsformations of se deterministic understand the continuous-time
Skills	The students are able to describe and analyse using methods of signal and system theory. I important properties such as magnitude and p the impact of LTI systems on the signal propert	They can analyse and design hase response, stability, line	n basic sys earity etc T	tems regarding
Personal Competence				
Social Competence	The students can jointly solve specific problem			
Autonomy	The students are able to acquire relevant inforcement their level of knowledge during the lecclicker system.			-
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	19() min			
	General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory	m): Specialisation Process E m): Specialisation Bioproces program): Specialisation program): Specialisation m): Specialisation Biomedica am, 7 semester): Specialisation am, 7 semester): Specialisation m, 7 semester): Specialisation m, 7 semester): Specialisation m, 7 semester): Specialisation	ngineering: s Engineering Civil- and Mechanical al Engineerin tion Electric sation Com ation Proces on Bioproces	Compulsory ng: Compulsory Enviromenta Engineering ng: Compulsory al Engineering puter Science as Engineering as Engineering as Engineering
	General Engineering Science (German progra	m, r semester). Specialisatio	ii wediaiil	ai Engineening



Focus Biomechanics: Compulsory

Assignment for the

**Following Curricula** 

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

Focus Energy Systems: Compulsory

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

Focus Aircraft Systems Engineering: Compulsory

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

rocus Materiais in 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 Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

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

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

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

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

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

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

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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



Caurage						
Courses						
<b>Title</b> Bioprocess Engineering - Fu	indamentals (L0841)			<b>Typ</b> ₋ecture	Hrs/wk 2	<b>CP</b> 3
Bioprocess Engineering - Fu				Recitation Section (large)	2	1
	undamental Practical Course	(L0843)		Practical Course	2	2
Module Responsible	Prof. Andreas Liese					
Admission Requirements	None					
Recommended Previous Knowledge	l none module "organic ch	nemistry", mo	dule "fundam	entals for process engi	neering"	
	After taking part successf	ully, students	have reached	d the following learning	results	
Professional Competence		-				
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classify different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processes in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail.					
Skills  Personal Competence  Social Competence	corresponding pa  predict qualitative growth inhibition of analyze bioproces distinguish betwee aerobic as well biotechnical prob propose solutions models  to explore new kn identify scientific p to document and of	t kinetic appurameters ely the influer on the fermer sses on basis een scale-up as microaer lem s to complica  owledge res problems with discuss their  module parti bility to take and scientific	roaches for go ace of energy ntation proces is of stoichiome criteria for dobic) to com ted biotechno ources and to a concrete ind procedures as cipants shoul position to the	generation, regenerations generation, regenerations generation, regenerations generations	on of redox e metabolic d bioproces s to apply to d deduce the d contents ulate solution ientific mann echnical que	equivalents and flux equations asses (anaerobothem to currents e corresponding assertions in small estions in small ener capacity for the equivalents and the estions in small ener estions in small ener estions in small ener eapacity for the equivalents and the estions in small energy for the estions in the estions in the estions in the estions in the estions in the estion energy for the estions in the estion energy for the estions in the estion energy for the estion energy for the estimated energy for the
	independently by organiz	zing their wor	kflow and to	oresent their results in a	-	
	Independent Study Time	96, Study fir	ne in Lecture	84		
Credit points	I	Fa		Dagadettee		
Studienleistung	Yes None	Form Subject practical w	theoretical ork	<b>Description</b> and		
Examination	Written exam					
Examination duration and scale	90 min					
	General Engineering Sci General Engineering Sci General Engineering Sc Compulsory	ence (Germa	n program): S	pecialisation Bioproce	ss Engineeri	ng: Compulso



	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: 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  Technomethematics: Specialization III. Engineering Science: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory  Process Engineering: Core qualification: Compulsory
	1 100033 Engineering. Our quanication. Ouripulsory

Course L0841: Bioproce	ss 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	<ul> <li>Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture</li> <li>Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese)</li> <li>Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese)</li> <li>Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)</li> <li>Kinetic of subtrate consumption and product formation (Prof. Zeng)</li> <li>Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)</li> <li>Transport process in a bioreactor (Prof. Zeng)</li> <li>Technology of sterilization (Prof. Zeng)</li> <li>Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)</li> <li>Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)</li> </ul>
Literature	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> </ul>



Typ Recitation Section (large)	
Typ Heditation desirent (large)	
Hrs/wk 2	
<b>CP</b> 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	
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	



Courses				
Title Heat and Mass Transfer (Lo Heat and Mass Transfer (Lo Heat and Mass Transfer (Lo	0102)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	<b>CP</b> 2 2 2
Module Responsible	<u> </u>	ricontation coolion (targe)	•	
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynan	nics		
<b>Educational Objectives</b>	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of explain procedural apparatus (e. g. heat ex</li> <li>They are capable of distinguish ar namely heat conduction, heat trans</li> <li>The students have the ability to explain describe mass transfer qualitative at they are able to depict the analogy linked processes in detail.</li> </ul>	changer, chemical reactors).  nd characterize different kinds of fer and thermal radiation.  xplain the physical basis for mained quantitative by using suitable	f heat trans ass transfer a mass trans	fer mechanism in detail and to fer theories.
Skills	<ul> <li>The students are able to set reason using the gained knowledge and respectively.</li> <li>They are capable to solve specific temperature alteration in fluids) and Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish between They can use this knowledge for column, rectification column).</li> <li>In this context, the students are capable to context apparatus.</li> <li>In addition, they can calculate both apparatus.</li> <li>The students are capable to connext of other courses (In particular the process engineering) to solve concentric to solve concentric transfer of the students are capable to connext of other courses (In particular the process engineering) to solve concentric transfer of the students are capable to connect the students</li></ul>	d to balance the corresponding to heat transfer problems (e.g. to calculate the corresponding to students can execute scaling to the description and design of the description and design of coable to choose and design functional considering their advantages and the courses thermodynamics, fluid to courses thermodynamics, fluid	heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate process this course	emical reactors cal processes of d mass transfer (e.g. extraction pes of heat and disadvantages es in procedura
Personal Competence  Social Competence	The students are capable to work results orally in a reasonable mann		n teams an	d to present the
	<ul> <li>The students are able to find and ex</li> <li>They are able to prove their lever procedure continuously (clicker-sy</li> </ul>	vel of knowledge during the o	course with	accompanying



Autonomy	control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Studienleistung	None
Examination	Written exam
Examination duration and scale	120 minutes; theoretical questions and calculations
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Science (English Elective Compulsory Science: Elective Compulsory Science: Elective Compulsory Science: Elective Compulsory Science: Ele



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	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>

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: Th	ermal Separation Processes			
Courses				
Title Thermal Separation Process Thermal Separation Process Thermal Separation Process	ses (L0119)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 2 1
Separation Processes (L11	59)	Practical Course	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodyna	mics III		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students can distinguish and describe different types of separation processes such as distillation, extraction, and adsorption</li> <li>The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems</li> <li>They have good knowledge of designing methods for separation processes and devices</li> </ul>			
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a give separation process and can close the associated energy and material balances</li> <li>The students can use different graphical methods for the designing of a separation proce and define the amount of theoretical stages required</li> <li>They can select and design a basic type of thermal separation process for a given case base on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties fro appropriate sources (diagrams and tables)</li> <li>They can calculate continuous and discontinuous processes</li> <li>The students are able to prove their theoretical knowledge in the experimental lab work.</li> <li>The students are able to discuss the theoretical background and the content of the experimental work with the teachers in colloquium.</li> <li>The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, flumechanics and chemical engineering.</li> </ul>		aration process ven case based properties from ab work. content of the	
Personal Competence				
Social Competence	<ul> <li>The students can work technical assignments in small groups and present the comresults in the tutorial</li> <li>The students are able to carry out practical lab work in small groups and organize a function of labor between them. They are able to discuss their results and to document scientifically in a report.</li> </ul>			nize a functiona
Autonomy	<ul> <li>The students are capable to obtended themselves and assess their quality</li> <li>The students can proof the state of the this way control their learning process</li> </ul>	heir knowledge with exam rese		



Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Studienleistung	None			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 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 Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			



ourse L0118: Thermal	Separation Processes		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



urse L0119: Thermal	Separation Processes		
Тур	Recitation Section (small)		
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	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul> The students work on tasks in small groups and present their results in front of all students.		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



ırse L0141: Thermal	Separation Processes		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> </ul>		
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 37985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>		



ourse L1159: Separation	on Processes		
Тур	Practical Course		
Hrs/wk	1		
СР	1		
Workload in Hours	ndependent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE/EN		
Cycle	SoSe		
Content	The students work on eight different experiments in this practical course. For every one of the eigexperiments, a colloquium takes place in which the students explain and discuss the theoretic 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, it students write a report. They receive instructions in terms of scientific writing as well as feedback 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		
<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., W Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>			



## Module M0892: Chemical Reaction Engineering Courses Title Hrs/wk CP Typ Chemical Reaction Engineering (Fundamentals) (L0204) Lecture 2 Chemical Reaction Engineering (Fundamentals) (L0244) Recitation Section (large) 2 2 Experimental Course Chemical Engineering (Fundamentals) (L0221) 2 **Practical Course** 2 Module Responsible Prof. Raimund Horn Admission None Requirements Recommended Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+II Previous Knowledge as well as computational methods for engineers. Educational Objectives After taking part successfully, students have reached the following learning results **Professional** Competence The students are able to explain basic concepts of chemical reaction engineering. They are able to Knowledge 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. After successful completion of the module, students are able to: - apply different computational methods to dimension isothermal and non-isothermal ideal reactors, Skills - 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** After successful completition of the lab-course the students have a strong ability to organize Social Competence themselfes in small groups to solve issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers. The students are able to obtain further information and assess their relevance autonomously. Students Autonomy 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 Description **Compulsory Bonus** Form Studienleistung Subject theoretical and Yes None practical work **Examination** Written exam **Examination duration** 120 min and scale General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Assignment for the Bioprocess Engineering: Core qualification: Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Course L0204: Chemical Reaction Engineering (Fundamentals)	
Typ Lecture	

Process Engineering: Core qualification: Compulsory

Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:



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

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, massconcentration, 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, elementspecies-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, Damköhlernumber, differential and integral method of kinetic analysis, laboratory reactors for kinetic Content 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, molebalance 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)

lecture notes Raimund Horn

skript Frerich Keil

Books:



M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Che	mie,
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 Literature

- 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	
·	•	

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



### Contont

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, molebalance 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)

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

# Literature

- 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



ourse L0221: Experime	ental 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)



Courses				
<b>Title</b> Practical Course: Measurem Measurement Technology fo	nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118)	Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Dr. Sven Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	Students are able to name the most important fundmentals of the Measurement Techno (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors Systems).			
Knowledge	They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency).			
	They can describe important methods of Chromatography)	f chemical Analysis (Gas Se	ensors, Spe	ectroscopy, G
Skills	Students can select suitable measuring methods to given problems and can use referin measurement devices in practice.  The students are able to orally explain issues in the subject area of measurement technology an solution approaches as well as place the issues into the right context and application area.			
Personal Competence  Social Competence	Students can arrive at work results in groups and document them in a common report.			
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			
Studienleistung	Compulsory Bonus Form  Yes None Subject theo practical work	<b>Description</b> retical and		
Examination	Written exam			
Examination duration and scale	105 minutes			
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory	n program): Specialisation  gram): Specialisation Biomedica gram): Specialisation Process E program, 7 semester): S  gram, 7 semester): Specialisation	Mechanica al Engineeri Engineering pecialisation on Mechanic	Il Engineerin ing: Compulso : Compulsory n Energy ar cal Engineerin



General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

Following Curricula General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Tyn	Practical Course
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	-
	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologic determine different gaseous pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna 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 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	<ul> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförm Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhe Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 2455 Bl.1</li> <li>Versuch 2:</li> </ul>
	<ul> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> </ul> Versuch 3:
	<ul> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Ver Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge</li> </ul>



Tvn	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Language	DE
Cycle	
Content	Fundamentals     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 fron the class.
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 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	Dr. Sven Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



<b>Fitle</b> ntroduction to Control Syste				
ntroduction to Control Syste		Тур	Hrs/wk	СР
ntroduction to Control Syste	, ,	Lecture Recitation Section (sma	2 II) 2	4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and s	ystems in time and frequency domain, La	aplace transfor	rm
Educational Objectives	After taking part successfully, stu	udents have reached the following learni	ng results	
Professional Competence				
Knowledge	particular explain proper  They can explain the d terms of frequency response  They can explain the Nyone They can explain the role  They can explain the waresponse	dynamic system behavior in time and fities of first and second order systems ynamics of simple control loops and in onse and root locus quist stability criterion and the stability may be of the phase margin in analysis and syrvay a PID controller affects a control loss arising when controllers designed in	terpret dynam argins derived nthesis of cont pop in terms	nic properties i from it. rol loops of its frequence
Skills	vice versa  They can simulate and a  They can design PID cor  they can analyze and frequency response tech  They can calculate disc and use it for digital imple	crete-time approximations of controllers	ol loops -Nichols) tunii the help of designed in	ng rules root locus an continuous-tim
Personal Competence				
Social Competence	_	oups to jointly solve technical problems	, and experin	nentally validat
	experiment guides) and use it w	on from provided sources (lecture no then solving given problems. ge in weekly on-line tests and thereby con		
Workload in Houre	Independent Study Time 124, S	tudy Time in Lecture 56		
Credit points		tady Time in Lecture 30		
Studienleistung				
Examination				
Examination duration and scale				



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

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

## Assignment for the General Englowing Curricula 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: Compulsory

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

i i					
	Lecture				
Hrs/wk					
СР					
	ndependent Study Time 92, Study Time in Lecture 28				
	Prof. Herbert Werner				
Language					
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 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	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, I 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>				



Course L0655: Introduct	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		



Courses					
Title			Тур	Hrs/wk	СР
Practical Exercise Environm	nental Technology (L1387)		Practical Course	1 11 5/WK	1
Environmental Technologie			Lecture	2	2
Module Responsible	Dr. Joachim Gerth				
Admission Requirements	INOne				
Recommended Previous Knowledge	Fundamentals of inorganic/	organic chemistry and I	piology		
<b>Educational Objectives</b>	After taking part successfull	y, students have reache	ed the following learn	ing results	
Professional Competence					
Knowledge	With the completion of technology. They are able give an overview of scientifimethods.	to describe the behavi	our of chemicals in t	he environment	t. Students ca
Skills	Students are able to proportion problems. They are able pollutants to migrate and trenvironmental Technology these opinons in front of an	to determine geoche ansform. The students contributes to sustaina	emical parameters ar are able to work out	nd to assess th well founded op	ne potential pinions on ho
Personal Competence					
Social Competence	The students are able to d multidisciplinary. They are discuss their theoretical or p	able to develop differe	nt approaches to the	-	•
Autonomy	Students can independently tranfer it to new problems.	y exploit sources about	of the subject, acquire	e the particular l	knowledge ai
Workload in Hours	Independent Study Time 48	s, Study Time in Lecture	42		
Credit points	3				
Studienleistung	Vas None	Form Subject theoretical oractical work	<b>Description</b> and		
	I				
Examination	Written exam				
Examination Examination duration and scale	1 hour				



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

Course L1387: Practical	Exercise Environmental Technology		
Тур	Practical Course		
Hrs/wk	1		
СР			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Joachim Gerth		
Language	DE		
Cycle	SoSe		
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material.  Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.		
Literature	F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308  W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317  C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution"  TUB Signatur GWC-515		

Course L0326: Environn	nental Technologie			
Тур	Lecture			
Hrs/wk				
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta			
Language	DE			
Cycle	WiSe			
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>			
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)			



Module M0539: Pr	ocess and Plant E	ngineering I			
Courses					
Title			Тур	Hrs/wk	СР
Process and Plant Engineer			Lecture	2	2
Process and Plant Engineer Process and Plant Engineer			Recitation Section (large) Recitation Section (small)	1	2
			necitation Section (Smail)	-	2
Module Responsible	j				
Admission Requirements	INone				
D	unit operation of thermal	an dmechanical separation	on processes		
Recommended Previous Knowledge	chemical reactor eingine	eering			
Educational Objectives	After taking part success	fully, students have reach	ed the following learning	results	
Professional					
Competence					
	students can:				
	classify and formulate bl	obal balance equations of	f chemical processes		
K. L. L. L.	specify linear componen	t equations of complex ch	emical processes		
Knowledge					
	explain linear regression	n and data reconcilliation p	oroblems		
	explain pfd-diagrams				
	students are capable of				
	- formulation of mass and	d energy balance equation	ns and estimation of prod	luct streams	
	- estimation of component streams of chemical plants using linear component balance models				
Skills - solution of data reconcilliation tasks					
	- conduction of process s	synthesis			
	- economic evaluation of	f processes and the estima	ation of production costs		
	- economic evaluation of	processes and the estima	alion of production costs		
Personal Competence					
Social Competence	1				
Autonomy	1				
	J	124, Study Time in Lectu	re 56		
Credit points	I				
Ctudio ploietum	Compulsory Bonus	Form	Description		
Studienleistung	Yes 10 %	Subject theoretical practical work	and		
Examination	Written exam	P			
Examination duration and scale	120 Min. lectures notes a	and books			
	General Engineering Sci General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Environmental Engineering		Specialisation Bioproces, 7 semester): Specialisation semester): Specialisation fram, 7 semester fram, 7 sem	ss Engineerii ation Proces	ng: Compulso ss Engineeringss Engineering
Assignment for the Following Curricula	General Engineering Sci	: Core qualification: Comp ience (English program): { ience (English program): {	Specialisation Bioprocess		



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory

Compulsory

Process Engineering: Core qualification: Compulsory

avT	Lecture				
Hrs/wk					
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Georg Fieg				
Language	DE				
Cycle	SoSe				
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					
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133				



U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung	
Blazek und Bergamann, Frankfurt, 2000	
LB was Circle Costana Davisa Madalina and Matauradalina Blazura Bress New York 1001	

J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 Literature

- T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
- G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
- D. Hairston, Chemical Engineering, October 2001, S. 31-37
- J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
- J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511
- K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
- S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
- J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
- P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
- G. Kaibel, Dissertation, TU München, 1987
- G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
- G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
- H.J. Lang, Chem. Eng. 54(10),117, 1947
- H.J. Lang, Chem. Eng. 55(6), 112, 1948
- F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process	course L0096: Process and Plant Engineering I			
Тур	Recitation Section (large)			
Hrs/wk	Hrs/wk 1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Lecturer Prof. Georg Fieg			
Language	DE			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L1214: Process	Course L1214: Process and Plant Engineering I			
Тур	Recitation Section (small)			
Hrs/wk	Hrs/wk 1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Lecturer Prof. Georg Fieg			
Language	DE			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			



Γitle			Тур	Hrs/wk	СР
Particle Technology I (L0434			Lecture	2	3
Particle Technology I (L0435 Particle Technology I (L0440			Recitation Section (small)	1	1
	<u>,                                      </u>		Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Requirements	None				
Recommended Previous Knowledge	keine				
Educational Objectives	After taking part succes	ssfully, students have reach	ned the following learning	results	
Professional					
Competence	After successful compl	letion of the module student	te are able to		
Knowledge	name and expl	lain processes and unit-opo articles, particle distributions	erations of solids process		,
Skills	solids propertie  asses solids wi	esign apparatuses and process of the product ith respect to their behavior work scientifically.	·		to the desire
Personal Competence					
		to discuss scientific topics of echnical-scientific issues in		or scientific p	ersonal and t
Autonomy	Students are able to ar	nalyze and solve questions	regarding solid particles	independent	ly.
Workload in Hours	Independent Study Tin	me 110, Study Time in Lectu	ure 70		
Credit points	6				
	Compulsory Bonus	Form	Description		
Studienleistung	Yes None	Written elaboration	sechs Berichte ( 5-10 Seiten	pro Versuch	ein Bericht) a
Examination	Written exam				
Examination duration and scale	90 minutes				
	General Engineering S General Engineering Engineering: Compuls General Engineering Compulsory General Engineering S Compulsory	Science (German program): Science (German program): Science (German program): Science (German program) Science (German program) Science (German program, Science (German program) Gring: Compulsory	: Specialisation Bioproces gram): Specialisation E n, 7 semester): Specialisation 7 semester): Specialisation	s Engineerin Energy and ation Proces	g: Compulsor Enviromenta s Engineering s Engineering



General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Process Engineering: Core qualification: Compulsory

Course L0434: Particle	Fechnology I		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Stefan Heinrich		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Description of particles and particle distributions</li> <li>Description of a separation process</li> <li>Description of a particle mixture</li> <li>Particle size reduction</li> <li>Agglomeration, particle size enlargement</li> <li>Storage and flow of bulk solids</li> <li>Basics of fluid/particle flows</li> <li>classifying processes</li> <li>Separation of particles from fluids</li> <li>Basic fluid mechanics of fluidized beds</li> <li>Pneumatic and hydraulic transport</li> </ul>		
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990.  Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.		

Course L0435: Particle	Technology I
Тур	Recitation Section (small)
Hrs/wk	1
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	Fechnology 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	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



Module M0829: Fo	undations of Management					
Courses						
Title  Management Tutorial (L088) Introduction to Management	•	Typ Recitation Section (large) Lecture	<b>Hrs/wk</b> 2 3	<b>CP</b> 3 3		
Module Responsible	Prof. Christoph Ihl					
Admission Requirements						
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business					
	After taking part successfully, students have rea	ched the following learning	results			
Professional Competence						
	After taking this module, students know the important basics of many different areas in Business an Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to  • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management					
Knowledge	<ul> <li>explain the most important aspects of and goals in Management and name the most in aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and supply chain management, organization and human ressource management, informanagement, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situation multiple objectives and uncertainty, and explain some basic methods from math Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>					
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry 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 ris 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			y are able to and under risk s ms		
Personal Competence						
Social Competence	Students are able to  work successfully in a team of students  to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project  to communicate appropriately and  to cooperate respectfully with their fellow students.			vrite a coheren		
Autonomy	Students are able to  work in a team and to organize the team to write a report on their project.	n themselves				
-	Independent Study Time 110, Study Time in Le	cture 70				
Credit points	6					
Studienleistung						
-	Subject theoretical and practical work					
Examination duration						



## and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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

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

## Assignment for the Following Curricula

Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

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:



Compulsor	Co	mpu	llsor
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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 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 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: Managen	nent Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek
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 self-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.



ırse L0880: Introduct	ion to Management				
	Lecture				
Hrs/wk	3				
СР					
Workload in Hours	ndependent Study Time 48, Study Time in Lecture 42				
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona				
Language	DE				
Cycle	WiSe/SoSe				
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management</li> <li>Important definitions from Management,</li> <li>Developing Objectives for Business, and their relation to important Business functions</li> <li>Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chai Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strategi information systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>Relevance of marketing, B2B vs. B2C-Marketing</li> <li>different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures</li> <li>basics of human ressource management</li> <li>Introduction to Business Planning and the steps of a planning process</li> <li>Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>Relevance of Controlling and selected Controlling methods</li> <li>Important aspects of Entrepreneurship projects</li> </ul>				
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.  Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.  Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008.  Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein 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: Inf	ormatics for Process Engineers				
Courses					
TitleTypHrs/wkCIInformatics for Process Engineers (L0836)Lecture22Informatics for Process Engineers (L0837)Recitation Section (small)22Numeric and Matlab (L0125)Practical Course22			2		
Module Responsible	Dr. Marcus Venzke				
Admission Requirements					
Recommended Previous Knowledge	Basic knowledge in using MS Windows.				
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results		
Professional Competence	Students can describe procedural and object-oriented concepts.				
Knowledge	Students are capable of object-oriented programming in the programing language Java and of solving				
Skills	mathematic questions by using Matlab.  Students are capable of developing concepts (simple algorithms) to solve technical questions.				
Personal Competence  Social Competence	Students are able to work out solutions together in	n small groups.			
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				
Studienleistung					
	Written exam				
Examination duration and scale	190 min				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Process Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Engrave and Environmental Engineering: Core qualification: Compulsory			Energy and as Engineering: ering: Elective ad Enviromental	



Course L0836: Informatics for 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 2D graphics Events and Controls	
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978  Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/  Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717  Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942  Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/  Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/	



Course L0837: Informati	cs for Process Engineers		
Тур	Recitation Section (small)		
Hrs/wk			
СР			
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	r. 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			
СР			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter		
Language	DE		
Cycle	SoSe		
Content	<ol> <li>Programming in Matlab</li> <li>Numerical methods for systems of nonlinear equations</li> <li>Basics in computer arithmetic</li> <li>Linear and nonlinear optimization</li> <li>Condition of problems and algorithms</li> <li>Verified numerical results with INTLAB</li> </ol>		
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		



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Courses					
Title	(1,0960)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2	
Environmental Assessment Environmental Assessment		Recitation Section (small)	1	1	
Module Responsible	Prof. Martin Kaltschmitt				
Admission	None				
Requirements					
Previous Knowledge	Fundamentals of inorganic/organic chemistry and biology				
Educational Objectives	After taking part successfully, students have r	eached the following learning	g results		
Professional					
Competence		nto convincia donth knowles	las of imposed	tont course offer	
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effe chains of potential environmental problems which might occur from production processes, projects construction measures. They have knowledge about the methodological diversity and are competed in dealing with different methods and instruments to assess environmental impacts. Besides the				
	students are able to estimate the complexity of and difficulties with their measurement.	of these environmental proce	sses as well	as uncertaintie	
	The students are able to select a suitable				
	assessment methods. Thereby they can denvironmental problems in a business co			_	
Skills	Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.				
Personal Competence	]				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical of 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 contex and are able to judge results of other publications.				
	Independent Study Time 48, Study Time in Le	ecture 42			
Credit points					
Studienleistung					
Examination duration	Written exam  1 hour written exam				
and scale		program). Chasi-li	Enorm:	d Englishment	
	General Engineering Science (German Engineering: Compulsory				
	General Engineering Science (German p Compulsory	rogram): Specialisation Pro	cess Engine	eering: Elective	
	General Engineering Science (German	program, 7 semester): S	Specialisation	n Energy and	
	Environmental Engineering: Compulsory	avam 7 aamaatav). Caasiali	D		
	General Engineering Science (German pro	gram, 7 semester): Specialis	sation Proce	ss Engineering	
	General Engineering Science (German pro Elective Compulsory General Engineering Science (German prog- Elective Compulsory				



Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Elective
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Elective Compulsory
	Process Engineering: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
Content	Contaminants: Impact- and Risk Assessment  Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)  Resource and water consumption: Material flow analysis  Energy consumption: Cumulated energy demand (CED), cost analysis  Life cycle concept: Life cycle assessment (LCA)  Sustainability: Comprehensive product system assessment, SEE-Balance  Management: Environmental and Sustainability management (EMAS)  Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	



Course L1054: Environmental Assessment		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE	
Cycle	SoSe	
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better.  Within the group exercise students discuss the various technical and scientific tasks, both subject-	
	specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.	
Literature	Power point Präsentationen	



## **Thesis**

Module M-001: Ba	chelor Thesis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	According to General Regulations §21 (1):
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<ul> <li>The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods).</li> <li>On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise.</li> <li>The students are able to outline the state of research on a selected issue in their subject area.</li> </ul>
Skills	<ul> <li>The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems.</li> <li>With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions.</li> <li>The students can take up a critical position on the findings of their own research work from a specialized perspective.</li> </ul>
Personal Competence	
Social Competence	<ul> <li>Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> <li>The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly.</li> </ul>
Autonomy	<ul> <li>The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame.</li> <li>The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.</li> <li>The students can apply the essential techniques of scientific work to research of their own.</li> </ul>
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	12
Studienleistung	None
Examination	Thesis
Examination duration and scale	I According to General Regulations
	General Engineering Science (German program): Thesis: Compulsory



General Engineering Science (German program, 7 semester): Thesis: Compulsory

Civil- and Environmental Engineering: Thesis: Compulsory

Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory

Energy and Environmental Engineering: Thesis: Compulsory General Engineering Science (English program): Thesis: Compulsory

General Engineering Science (English program, 7 semester): Thesis: Compulsory

Computational Science and Engineering: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory

Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory

Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory

xx: Thesis: Compulsory

Assignment for the

**Following Curricula** 

Process Engineering: Thesis: Compulsory