

Module Manual

Bachelor of Science

General Engineering Science (English program)

Cohort: Winter Term 2014

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Program description

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The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study, some of them with further specialisations. GES is designed as an intensive course of studies, with a higher workload than 180 credit points. The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studyies, of another technical or of an economic oriented Master study. Most of the modules in the 1st and the 2nd semester of GES are offered in English.

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Core qualification

Module M0701: Chemistry (GES)				
-				
Courses	Courses			
Title		Тур	Hrs/wk	CP
Chemistry (GES) I (L0467)		Lecture	2	2
Chemistry (GES) I (L0478)		Recitation Section (large)	1	1
Chemistry (GES) II (L0469)		Lecture	2	2
Chemistry (GES) II (L0479)		Recitation Section (large)	1	1
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (English program): Core qualification: Com	pulsory		
Curricula				

Course L0467: Chemistry (GES) I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload	Independent Study Time 32, Study Time in Lecture 28	
in Hours		
Lecturer	Dr. Christoph Wutz	
Language	EN 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	- Gallagher, Ingram: Complete Chemistry (Oxford University Press)	
	- Corwin: Introductory Chemistry (Pearson)	
	- Burrows, Parsons, Price, Holman: Chemistry3 (Oxford University Press)	

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



Course L0	1469: Chemistry (GES) II		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload	Independent Study Time 32, Study Time in Lecture 28		
in Hours			
Lecturer	Dr. Christoph Wutz		
Language	EN		
Cycle	WiSe		
Content	nt - Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,		
	- Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars		
	- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction		
	- Practical apllications and examples		
Literature	- Gallagher, Ingram: Complete Chemistry (Oxford University Press)		
	- Corwin: Introductory Chemistry (Pearson)		
	- Burrows, Parsons, Price, Holman: Chemistry3 (Oxford University Press)		

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



Module M0736: Linear Alge	ebra			
Courses				
Title		Тур	Hrs/wk	CP
Linear Algebra (L0642)		Lecture	4	4
Linear Algebra (L0643)		Recitation Section (large)	2	2
Linear Algebra (L0645)	T	Recitation Section (small)	2	2
Module Responsible	NN			
Admission Requirements				
Recommended Previous	School mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge Skills	 Students can name the basic concepts in linear algebra. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112			
Credit points	8			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	Computer Science: Core qualification: Compulsory			
Curricula	General Engineering Science (English program): Core qualifica	tion: Compulsory		

Course L0642: Linear Algebra		
Тур	Lecture	
Hrs/wk	4	
CP	4	
	Independent Study Time 64, Study Time in Lecture 56	
Lecturer	NN	
Language		
Cycle		
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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L0645: Linear Algebra	
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses Title Electrical Engineering I (L0677) Electrical Engineering I (L0679) Module Responsible Pr Admission Requirements Recommended Previous	rof. Manfred Kasper	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 5
Electrical Engineering I (L0677) Electrical Engineering I (L0679) Module Responsible Pr Admission Requirements	rof. Manfred Kasper	Lecture	3	5
Electrical Engineering I (L0677) Electrical Engineering I (L0679) Module Responsible Pr Admission Requirements	rof. Manfred Kasper	Lecture	3	5
Electrical Engineering I (L0679) Module Responsible Pr Admission Requirements	rof. Manfred Kasper		2	1
Admission Requirements	rof. Manfred Kasper			•
Recommended Previous				
Knowledge				
Educational Objectives Af	fter taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge Th	he students know the basic theory, relations and methods of	direct current networks and of electric and m	nagnetic fields. This in	cludes especially:
	Kirchhoffs voltage and current laws,			
	Ohm's law,			
	 methods to simplify and analyze direct current network 	ve.		
	description of electric and magnetic fields by use of ve			
	Basic material relations.	cional nela quantines,		
	Gauss's law,			
	Ampère's law,			
	induction law,			
	Maxwell's equation in the integral form,			
	concept and definition of resistance, capacitance and	industance		
	• concept and delimition of resistance, capacitance and	mudciance.		
Skills Th	he students are able to establish relations between curre	ents and voltages in simple direct current r	networks and to apply	these to calculate an
di	imension networks. Student know to apply the fundamental	laws of electric and magnetic fields and are	able to derive and eva	aluate relations betwee
fie	eld quantities. Students know to calculate resistance, capaci	tance and inductance of simple geometric ar	rangements.	
Personal Competence				
•	students are able to solve specific problems alone or in a gre	oup and to procent the regults accordingly.	tudonto con ovolcio co	anconte and on the besi
, and the second		oup and to present the results accordingly. S	dudents can explain co	incepts and on the bas
Of	f examples verify and deepen their understanding.			
Autonomy St	students are able to acquire particular knowledge using tex	ktbook in a self-learning process, to integra	te, present and associ	ate this knowledge wit
*	ther fields. The students develop perseverance to also solve		7.	· ·
	ndependent Study Time 110, Study Time in Lecture 70			
Credit points 6				
Examination W	Vritten exam			
Examination duration and scale 12	20 minutes			
Assignment for the Following Ge	General Engineering Science (English program): Core qualifi	cation: Compulsory		
Curricula				

Course L0677: Electrical Engineering I		
Тур	Lecture	
Hrs/wk	3	
CP	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Manfred Kasper	
Language	EN	
Cycle	WiSe	
Content	1. Basics of Resistive Circuits 2. Simplifying Resistive Circuits 3. Network Analysis 4. The Electrostatic Field 5. Stationary Currents in Conductive Media 6. Electrostatic Field in Non-Conductive Media 7. Static Magnetic Field 8. Induction and Time-Dependent Fields	
Literature	 M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013 A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008 P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996 M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004 F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005 	



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



Module M1081: Mechanics	I (GES)			
Courses				
Title		Тур	Hrs/wk	СР
Mechanics I (GES) (L1373)	Mechanics I (GES) (L1373)			3
Mechanics I (GES) (L1374)		Recitation Section (large)	3	3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The primary purpose of the study of Statics is to develop the ca	apacity to predict the effects of forces of	n rigid bodies, structu	ral elements and simple
	structures, which are at rest (in equilibrium). Such a capacity is cr	itical to the design of many structural or	engineering systems.	The particular objectives
	of this course are to:			
		and the affects of forces and indian		
	Introduce the student to the basic principles required to	analyse the ellects of forces applied to	o rigia bodies, structu	rai elements and simple
	structures in equilibrium;	idealized mathematical models of real	anaina arina avatama	
	Demonstrate sound techniques of constructing and solving Promote the analytical and problem-solving skills required			
	3. Fromote the analytical and problem-solving skills required	to solve a wide variety of real engineers	ng problems ellectiver	у.
Skills	At the end of this course the student is able to:			
	Apply the properties of two- and three-dimensional force s	stems to the analysis of structural elem-	ents and simple structu	ıres in equilibrium.
	2. Isolate a body in equilibrium by drawing its free-body diago	ram on which all forces acting on the bo	dy are represented.	
	3. Analyse the external effects of forces acting on a single bo	dy or a system of bodies in two- and thre	ee-dimensional equilib	orium using the free-body
	diagram of the body or system.			
	 Analyse the internal forces in trusses and beams. 			
	Solve problems of equilibrium with account for dry friction.			
	6. Determine mass centres and centroids of lines, areas and	volumes.		
Personal Competence				
Social Competence	Students can: - work in groups and report on the findings, - de	velop joint solutions in mixed teams a	and present them to o	thers, - assess the team
	collaboration and their own share in it.			
Autonomy	Students are able to: - solve the problems independently with the	help of hints, - assess their own strength	ns and weaknesses, e.	g. with the aid of the mid-
	term test.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	1.5 hours Statics: force systems, equilibrium, mass center, friction,	trusses, beams.		
Assignment for the Following	General Engineering Science (English program): Core qualification	n: Compulsory		
Curricula				

Course L1373: Mechanics 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	 Two-dimensional (2D) force systems: moment of a force about a point, reduction of a system of forces, resultant. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity. Equilibrium in two and three dimensions. Equations of equilibrium. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses. Simple structures: frames and machines. Mass centers and centroids of lines, areas and volumes. Friction: dry friction, types of friction problems. Beams: internal effects- internal forces. Internal forces in curved-in-plane members. * Flexible cables. * Virtual work principle. * Denotes an additional topic. 	
Literature	 J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition. 	



Course L1374: Mechanics I (GES)		
Тур	Recitation Section (large)	
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	 Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity. Equilibrium in two and three dimensions. Equations of equilibrium. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses. Simple structures: frames and machines. Mass centers and centroids of lines, areas and volumes. Friction: dry friction, types of friction problems. Beams: internal effects- internal forces. Internal forces in curved-in-plane members. *Flexible cables. *Virtual work principle. *Denotes an additional topic. 	
Literature	 J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4th Edition. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition. 	



Module M1139: Physics for	Engineers (GES)			
Courses				
Title		Тур	Hrs/wk	CP
Physics for Engineers (GES) (L0557)		Lecture	2	3
Physics for Engineers (GES) (L0560)		Recitation Section (small)	1	1
Physics-Lab for ET/IIW-Engineers (L0948)		Laboratory Course	1	2
Module Responsible	Dr. Alexander Petrov			
Admission Requirements	Highschool Diploma			
Recommended Previous	October and Proposition on Fight asked to			
Knowledge	Calculus and linear algebra on high school level	91		
	Physics on high school level			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of p	hysics such as in the areas of mechanics, oscillation	ons,	
	waves, and optics.			
	Students can relate physics topics to technical problem			
Chille			-4	
Skills	Students can describe physical problems mathematica	ny and solve such problems within the framework	OI	
	their acquired mathematical expertise.			
	Students are able to write meaningful reports on experi	ments and to discuss the results in a conclusive w	ay.	
Personal Competence				
Social Competence	Students can jointly solve subject related problems in g	groups. They can present their results effectively		
	within the framework of the problem solving and lab co	urses.		
Autonomy	Students are capable to extract relevant information fr	•		•
	reflect their acquired level of expertise with the help	, , ,	n typical exam questio	ons. Students are able to
	connect their knowledge with that acquired from other I	ectures.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	3		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min, 10 problems with two parts a) and b) plus phy	sics lab attestation		
Assignment for the Following	General Engineering Science (English program): Core qualification: Compulsory			
Curricula				

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



Course L0560: Physics for Engineers (GES)	
Тур	Recitation Section (small)
Hrs/wk	1
CP	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

course L0948: Physics-Lab for ET/IIW-Engineers		
Тур	Laboratory Course	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hansen	
Language	DE/EN	
Cycle	SoSe	
Content	In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and	
	optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in	
	the course "Physics for TUHH-ET Engineers".	
	Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of	
	physical equipment, analysis of the results and preparation of a report on the experimental data.	
Literature	Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.	
	Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung	
	"Physik für TUHH-ET Ingenieure" angegebene Literatur gut geeignet ist.	



	al Complementary Courses for Bachelors
Module Responsible	Dagmar Richter
Admission Requirements Recommended Previous	none take a look at lecture descriptions
Knowledge	
Educational Objectives Professional Competence	After taking part successfully, students have reached the following learning results
·	The Non-technical Elective Study Area
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliar management, collaboration and professional and personnel management competences. The department implements these training objective teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students caby opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two catalogues for nontechnical complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the "non-technical department" for specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also 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 of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the catudies.
	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 interdisc and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication stusustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will 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 commisskills, 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 in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical 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 Ba 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 special series are subject to individual and socio-cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
56	In selected sub-areas students can
	 apply basic methods of the said scientific disciplines, auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline, to handle simple questions in aforementioned scientific disciplines in a sucsessful manner, justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationsh subject.

Social Competence | Personal Competences (Social Skills)

Students will be able

• to learn to collaborate in different manner,



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

Courses

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



Module M0671: Technical 1	Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics I (L0437)		Lecture	2	4
Technical Thermodynamics I (L0439)		Recitation Section (large)	1	1
Technical Thermodynamics I (L0441)		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous	Elementary knowledge in Mathematics and Mechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lear	ning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamic. They know the	e relation of the kinds of energy ac	cording to 1st law of	Thermodynamic and are
	aware about the limits of energy conversions according to 2 nd law of T	hermodynamic. They are able to d	istinguish hetween sta	te variables and process
	variables and know the meaning of different state variables like temp			
	able to draw the Carnot cycle in a Thermodynamic related diagram. The			
	use the related equations of state. They know the meaning of a fundam			-
	asset the related equations of state. They know the meaning of a fundam	ionial state of equation and know a	e basies of two priase	memodynamic.
Skills	Students are able to calculate the internal energy, the enthalpy, the kir	netic and the notential energy as we	all as work and heat for	r eimple change of etates
Skills	and to use this calculations for the Carnot cycle. They are able to calculations	1 07		
	variables.	cuiale state variables for all ideal a	ind for a real gas from	measured mermai state
	variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an appro	aach		
· ·	Students are able to define independently tasks, to get new knowledge		a to find ways to use th	a knowladge in prostice
Autonomy	Students are able to define independently tasks, to get new knowledge	riioiii exisiirig kriowledge as well a	s to lind ways to use th	e knowledge in practice.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Core qualification: C	ompulsory		
Curricula	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsor	ry		
	General Engineering Science (English program): Core qualification: Co	ompulsory		
	Computational Science and Engineering: Specialisation Engineering S	Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Elective Cor	mpulsory		
	Process Engineering: Core qualification: Compulsory			



Course L0437: Technical Thermody	namics I		
Тур	Lecture		
Hrs/wk	2		
CP	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Gerhard Schmitz		
Language	DE		
Cycle	SoSe		
Content	1. Introduction		
	2. Fundamental terms		
	Thermal Equilibrium and temperature		
	3.1 Thermal equation of state		
	4. First law		
	4.1 Heat and work		
	4.2 First law for closed systems		
	4.3 First law for open systems		
	4.4 Examples		
	5. Equations of state and changes of state		
	5. Equations of state 5.1 Changes of state		
	5.2 Cycle processes		
	6. Second law		
	6.1 Carnot process		
	6.2 Entropy		
	6.3 Examples		
	6.4 Exergy		
	7. Thermodynamic properties of pure fluids		
	7.1 Fundamental equations of Thermodynamics		
	7.2 Thermodynamic potentials		
	7.3 Calorific state variables for arbritary fluids		
	7.4 state equations (van der Waals u.a.)		
Literature			
=1.0.4.4.0	Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009		
	Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012		
	- Daws M. Caranta C. Thermodynamics to Engineers Mc Carallill 1000		
	Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993		

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

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



Module M0737: Mathematic	al Analysis			
Courses				
Title		Тур	Hrs/wk	СР
Mathematical Analysis (L0647)		Lecture	4	4
Mathematical Analysis (L0648)		Recitation Section (large)	2	2
Mathematical Analysis (L0649)		Recitation Section (small)	2	2
Module Responsible	NN			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge Skills	 Students can name the basic concepts in analysis. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. Students can model problems in analysis with the help of the concepts studied in this course. Moreover, they are capable of solving them b applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points	8			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	Computer Science: Core qualification: Compulsory			
Curricula	General Engineering Science (English program): Co	re qualification: Compulsory		

Course L0647: Mathematical Analys	sis		
Тур	Lecture		
Hrs/wk	4		
СР	4		
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56		
Lecturer	NN		
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	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0649: Mathematical Analysis		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0772: Electrical E	ngineering II			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering II (L0747)		Lecture	3	5
Electrical Engineering II (L0748)		Recitation Section (small)	2	1
Module Responsible	Prof. Frank Gronwald			
Admission Requirements	None			
Recommended Previous	Content of the Lecture "Electrical Engineering I (Elektrotechnik I)	п		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students know the basic theory, relations and methods of	time dependent network theory and basic	nonlinear circuit ele	ments. This includes, in
	particular:			
	• transients,			
	the use of complex numbers and phasors,			
	the concept of impedance,			
	steady state sinusoidal circuit analysis,			
	 complex power and 3-phase systems, 			
	• transformers,			
	transfer function and filters,			
	•	• the concept of resonance,		
	diodes and rectifiers,			
	 bipolar transistors and operational amplifiers 			
Skills	The students are able to establish relations between time deper	ndent currents and voltages in linear netwo	orks. The students kn	ow how to apply network
	The students are able to establish relations between time dependent currents and voltages in linear networks. The students know how to apply network theory to analyze 3-phase systems, transformers, filter-like structures, and resonating networks. The students know to include basic nonlinear circuit			
	elements, such as diodes, bipolar transistors, and operational ar	nplifiers, into the network analysis.		
Personal Competence				
Social Competence	Students are able to solve specific problems, alone or in a group		udents can explain co	oncepts and, on the basis
	of examples and exercises, verify and deepen their understanding	ng.		
Autonomy	Students are able to acquire particular knowledge using textbo	oks in a self-learning process to integrate	nresent and accord	riate this knowledge with
Autonomy	other fields. The students develop persistency to also solve more		e, present, and assoc	nate this knowledge with
	other helds. The stadents develop persistency to also serve more	o complicated problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (English program): Core qualificat	ion: Compulsory		
Curricula	3 3 1 3 	F 7		
341110414				

Course L0747: Electrical Engineerin	ng II
	Lecture
Hrs/wk	
CP	
Cycle	SoSe
Content	 Transients Periodic and sinusoidal signals Power in AC circuits Three-phase systems Transformers Harmonic analysis, transfer functions, filters, locus curve, and Bode plot Resonant circuits Diodes and nonlinear circuits Bipolar transistor and operational amplifier
Literature	A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011) M. Albach: "Elektrotechnik", (Pearson, 2011).



Course L0748: Electrical Engineering	ng II
Тур	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Frank Gronwald
Language	EN
Cycle	SoSe
Content	The exercise sessions serve to deepen the understanding of the concepts of the lecture.
Literature	A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011) M. Albach: "Elektrotechnik", (Pearson, 2011).



Module M1103: Mechanics	II (GES)					
.						
Courses						
itle		Тур	Hrs/wk	CP		
lechanics II (GES) (L1417)		Lecture	2	3		
lechanics II (GES) (L1418)	Dec / Declaration beautiful to	Recitation Section (large)	2	3		
Module Responsible	Prof. Radoslaw Iwankiewicz					
Admission Requirements Recommended Previous						
Knowledge						
Educational Objectives	After taking part successfully, students have reached the follow	vina learnina reculte				
Professional Competence	Alter taking part successibility, students have reached the follow	and realisting results				
Knowledge	The primary purpose of the study of Mechanics of Materials/	Solids is to dovolon the conscitute predict	the offects of forces on	alactic badios, struct		
Knowieage						
	elements and simple structures, which are at rest (in equilibriu	in). Such a capacity is critical to the design	i oi many structural of e	rigineering systems.		
	particular objectives of this course are to:					
	Introduce the student to the basic principles required	to analyse the effects of forces applied to	elastic bodies, structu	ral elements and sim		
	structures in equilibrium;					
	Demonstrate sound techniques of constructing and sol	ving idealised mathematical models of real	l engineering systems;			
	Promote the analytical and problem-solving skills requi	red to solve a wide variety of real engineer	ring problems effectively	y.		
Skills	At the end of this course the student should be able to:					
	Determine average normal and shear stresses.					
	l -	torsion of a siroular shaft				
	Determine shear stresses and the angle of twist due to	torsion of a circular shall.				
	Determine thermal stresses in rods.					
		4. Analyse statically indeterminate rods and shafts				
	5. Determine area moments of inertia as well as principal					
	6. Determine normal and shear stresses as well as deflect	tions due to bending.				
	7. Analyse plane state of stress (stress transformation).					
	Analyse stability of equilibrium of simple systems and be Determine displacements and solve statically indeterm	*				
	1.					
Personal Competence						
Social Competence	Students can: -work in groups and report on the findings, -collaboration and their own share in it.	develop joint solutions in mixed teams a	and present them to ot	hers, - assess the te		
Autonomy	Students are able to; - solve the problems independently with	n the help of hints, - assess their own strer	ngths and weaknesses	, e.g. with the help of		
	mid-term test.					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Examination	Written exam					
Examination duration and scale	1.5 hours Mechanics of Solids: stress and strain due to axi methods.	al loading, torsion, bending, stress transfe	ormation, moments of	inertia, buckling, ene		
Assignment for the Following	General Engineering Science (English program): Core qualific	ation: Compulsory				
Curricula						



e L1417: Mechanics 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	COURSE CONTENTS:
	 Normal and shear stress, average normal and shear stress. Normal and shear strain. Axial loading: elastic deformation and statically indeterminate problems. Thermal stresses. Statically indeterminate axially loaded rods. Area moments of inertia. Torsion of a circular shaft: shear strain and stress, the angle of twist. Bending. Pure and symmetric bending: normal strain and stress. Deflection of beams: elastic curve. Statically indeterminate beams. Un-symmetric bending. Bending with a transverse shear: shear stresses in beams. Shear flow in thin-walled members, shear center. Plane-stress transformation. Stability of equilibrium and buckling of elastic columns. Elastic strain energy and energy methods: Castigliano's theorem – determination of displacements and statically indeterminate problems. *Membrane theory of rotational shells: thin-walled pressure vessels.* (*) denotes an additional topic.
Literature	R.C. Hibbeler, Mechanics of Materials, Pearson, Prentice Hall, SI 2 nd Edition .
	2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI 3 rd Edition

Course L1418: Mechanics II (GES)	Course L1418: Mechanics II (GES)	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	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	



Courses				
ïtle		Тур	Hrs/wk	CP
rogramming in C (L0083) rogramming in C (L1488)		Leberatory Course	1	1
Module Responsible	Prof. Siegfried Rump	Laboratory Course	'	ı
Admission Requirements	None			
Recommended Previous	Elementary PC handling skills			
Knowledge	Elementary i o nariding skins			
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	The students know by heart the basic syntax of C programming	as well as its meaning, intent and		
	purpose.			
	They know the fundamental components and principles of class	agentary, proceedural programming		
	They know the fundamental components and principles of elembased on C programming and can explain them:	lemary procedural programming		
	based on o programming and can explain them.			
	basic data types (integers, floating point numbers, characters)			
	advanced data types (pointers, arrays, strings, composed data			
	operators (arithmetical operations, logical operations, bit operations)	ations)		
	control flow (choice, loops, jumps, conditional compilation) functions and macros			
	important standard libraries and functions			
	• recursion			
	• linked lists			
	The students are prepared for continuing programming lecture	s like object oriented programming in C++		
Skills	The students know how to use an integrated development envi	ronment for C programming on a PC		
	so that they can write, store, compile and execute C programs	on it.		
	Using their knowledge they are able to read and understand gi	ven C Programs.		
	They can solve simple algorithmic problems on their own and on in C language.	ean model and program their solutions		
	iii o language.			
	The students are able to solve selected exercises from other ar	eas of their study like mathematics,		
	mechanics, electrical engineering or physics with the aid of sm	all C programs/-projects numerically.		
Personal Competence				
Social Competence	The students are able to work in small teams to solve given we	ekly tasks, to identify and analyze		
	programming errors and to present their results.			
	They are able to explain simple phenomena to each other dire	adio ad the DO		
	They are able to explain simple phenomena to each other dire	Buy at the FO.		
Autonomy	The students prepare themselves using the given teaching ma	erial and solve the given		
	programming exercises on their own.			
	Additionally, they write small C programs to understand and ch	eck addressed issues and also to		
	gain a certain programming experience.			
	For details have add the same of the best west the set of the	Alexander and a series of		
	For details beyond the scope of the lecture the students inform	tnemselves 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			
Examination	Homework			
Examination duration and scale	1-2 coding tasks weekly			
Assignment for the Following	General Engineering Science (German program): Core qualific	ation: Compulsory		
Curricula	General Engineering Science (English program): Core qualific	ation: Compulsory		



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

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



Module M0594: Fundament	tals of Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
	Fundamentals of Mechanical Engineering Design (L0258)		2	3
Fundamentals of Mechanical Engineering		Recitation Section (large)	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain basic working principles and functions of machi	ine elements		
	explain basic working principles and functions of machine explain requirements, selection criteria, application so		machine elemente in	dicate the background of
	dimensioning calculations.	change and practical examples of basic	, maonine ciemento, in	aroute the background of
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				
	Students are able to discuss technical information in the	e lecture supported by activating methods		
Autonomy				
ridionomy	Students are able to independently deepen their acquir	red knowledge in exercises.		
	Students are able to acquire additional knowledge a	nd to recapitulate poorly understood co	ntent e.g. by using the	video recordings of the
	lectures.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Core qualific	cation: Compulsory		
Curricula	Energy and Environmental Engineering: Core qualification: Co	mpulsory		
	General Engineering Science (English program): Core qualification	ation: Compulsory		
	Logistics and Mobility: Core qualification: Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compulsory			



Course L0258: Fundamentals of Me	chanical Engineering Design
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Lecture
	 Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts Presentation of technical objects, creation of production documentations (technical drawing)
	Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axis & shafts
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

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



Module M0688: Technical 1	hermodynamics II			
Courses				
Title		Тур	Hrs/wk	CP
Technical Thermodynamics II (L0449)		Lecture	2	4
Technical Thermodynamics II (L0450)		Recitation Section (large)	1	1
Technical Thermodynamics II (L0451)		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous	Elementary knowledge in Mathematics, Mechanics a	and Technical Thermodynamics I		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are familiar with different cycle processes I	ke Joule, Otto, Diesel, Stirling, Seiliger and Clausiu	s-Rankine. They are ab	le to derive energetic and
	exergetic efficiencies and know the influence differe	nt factors. They know the difference between anti cl	ockwise and clockwise	cycles (heat-power cycle
	cooling cycle). They have increased knowledge of	steam cycles and are able to draw the different cy	cles in Thermodynami	c related diagrams. They
	know the laws of gas mixtures, especially of humid	air processes and are able to perform simple comb	ustion calculations. The	y are provided with basic
	knowledge in gas dynamics and know the definition	of the speed of sound and know about a Laval nozz	le.	
Skills	Students are able to use thermodynamic laws for the	e design of technical processes. Especially they a	re able to formulate ene	ergy, exergy- and entropy
	balances and by this to optimise technical process	es. They are able to perform simple safety calculate	ions in regard to an ou	utflowing gas from a tank
	They are able to transform a verbal formulated mess	age into an abstract formal procedure.		
Paranal Commeters				
Personal Competence				
Social Competence	The students are able to discuss in small groups and	develop an approach.		
Autonomy	Students are able to define independently tasks, to g	et new knowledge from existing knowledge as well	as to find ways to use th	ne knowledge in practice.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): C	ore qualification: Compulsory		
Curricula	Bioprocess Engineering: Core qualification: Comput	sory		
	Energy and Environmental Engineering: Core qualif	ication: Compulsory		
	General Engineering Science (English program): Co	re qualification: Compulsory		
	Computational Science and Engineering: Specialisa			
	Mechanical Engineering: Core qualification: Compu	sory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Co	mpulsory		
	Process Engineering: Core qualification: Compulsor	у		

Course L0449: Technical Thermodynamics II	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	8. Cycle processes
	7. Gas - vapor - mixtures 10. Open sytems with constant flow rates
	11. Combustion processes 12. Special fields of Thermodynamics
Literature	 Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993



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

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



Module M1105: Mechanics	III (GES)			
Courses				
Title		Тур	Hrs/wk	CP
Mechanics III (GES) (L1421)		Lecture	3	3
Mechanics III (GES) (L1420)		Recitation Section (small)	2	2
Mechanics III (GES) (L1419) Module Responsible	Prof. Radoslaw Iwankiewicz	Recitation Section (large)	ı	ı
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	The primary purpose of the study of Mechanics III (Fluid Statics, K	inematics and Kinetics) is to develop	the capacity to predict	the effects of forces and
	motions, necessary for the analysis and design of moving machine	e parts, different machinery, vehicles	s, aircraft, spacecraft, au	tomatic control systems,
	etc.The particular objectives of this course are to:			
	Determine the hydrostatic forces acting on different objects.			
	Analyse stability of floating bodies.			
	Analyse the kinematics and kinetics of a particle in differen	t reference systems		
	Analyse the motion of the system of particles and forces actions.			
	Analyse the plane motion of a rigid body (simple mechanism			
	Analyse the three-dimensional motion of a rigid body and for			
Skills	At the end of this course the student should be able to:			
	Solve the equilibrium problems with account for hydrostatic parts.	praecura forcac		
	Analyse stability of simple floating bodies.	ressure lorces.		
	3. Calculate the velocity and acceleration of a particle in different rel	erence systems.		
	4. Derive and solve the equation of motion of a particle in dif	erent reference systems.		
	5. Analyse the motion of the system of particles and forces acting or	n it with the aid of work-energy and in	npulse-momentum relati	onships,
	Calculate the instantaneous linear and angular velocities and ac	celerations of the planar mechanism	S.	
	7. Derive and solve the equations of a plane motion of a rigid body	and find forces acting on it,		
	Apply work-energy and impulse-momentum relationships to analy			
	Calculate the instantaneous linear and angular velocities and ac		motion of a rigid body.	
	10. Derive the equations of a motion of a three-dimensional motion			
	11. Apply in three-dimensional kinematics and kinetics of rigid body	both methods of vector algebra and	I matrix methods.	
Personal Competence				
Social Competence	Students can: - work in groups and report on the findings, - deve	elop joint solutions in mixed teams	and present them to of	hers, - assess the team
	collaboration and their share in it.			
Autonomy	Students are able to: -solve the problems independently with the he	lp of hints, - assess their own strengt	hs and weaknesses, e.	g. with the aid of the mid-
	term test.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 hours Fluid Statics: hydrostatic pressure, buoyancy, stability of flo		of plane and 3D rigid b	od,y. Kinetics of particle,
A tonor	system of particles, of plane and 3D rigid body. Vector and matrix all	*		
Assignment for the Following	General Engineering Science (English program): Core qualification	Compulsory		
Curricula				

Course L1421: Mechanics III (GES)	
Тур	Lecture
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
Content	See interlocking course
Literature	See interlocking course



Course L1420: Mechanics III (GES)	
Тур	Recitation Section (small)
Hrs/wk	2
CP	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)		
Тур	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	FLUID STATICS	
	Fluid pressure, hydrostatic pressure on flat and cylindrical surfaces.	
	Buoyancy force, buoyancy center, metacenter, stability of floating objects.	
	KINEMATICS	
	1. Kinematics of a particle. Plane curvilinear motion: rectangular coordinates, normal and tangential coordinates, polar coordinates. Space	
	curvilinear motion.	
	2. Constrained motion of connected particles.	
	3. Plane kinematics of a rigid body.	
	Relative (compound) motion.	
	5. Three-dimensional kinematics of a rigid body.	
	KINETICS	
	Kinetics of a particle and of a system of particles.	
	Plane kinetics of a rigid body.	
	Three-dimensional kinetics of a rigid body.	
Literature	1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons, SI Version, 4 th Edition	
	rd	
	2 . R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3 rd Edition	



Module M0730: Computer I	Engineering			
Courses				
Courses		Tue	I lun hade	CP
Title Computer Engineering (L0321)		Typ Lecture	Hrs/wk 3	4
Computer Engineering (L0321) Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk	,	· · · · · · · · · · · · · · · · · · ·	
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	This module deals with the foundations of the functionality of con	nputing systems. It covers the layers t	rom the assembly-lev	vel programming down to
Ü	gates. The module includes the following topics:	, , , , , , , , , , , , , , , , , , , ,	,	, ,
	Introduction	Constitution of the state of th		
	Combinational logic: Gates, Boolean algebra, Boolean func Convertible size Flig flags a standard gustamatic hardware.		nai networks	
	Sequential logic: Flip-flops, automata, systematic hardware Technological foundations	design		
	Computer arithmetic: Integer addition, subtraction, multiplication.	tion and division		
	Basics of computer architecture: Programming models, MIPs			
	Memories: Memory hierarchies, SRAM, DRAM, caches	single-cycle architecture, pipelining		
	Input/output: I/O from the perspective of the CPU, principles	of possing data, point to point connect	iono buooso	
	imputoutput. #O from the perspective of the GPO, principles	or passing data, point-to-point connect	ioris, busses	
Skills	The students perceive computer systems from the architect's pe	rspective, i.e., they identify the inter-	nal structure and the	physical composition of
	computer systems. The students can analyze, how highly specif	c and individual computers can be l	ouilt based on a coll	ection of few and simple
	components. They are able to distinguish between and to explain	the different abstraction layers of today	y's computing systems	s - from gates and circuits
	up to complete processors.			
	After successful completion of the module, the students are able to	judge the interdependencies between	n a physical computer	r evetam and the coftware
	executed on it. In particular, they shall understand the consequence			
	the assembly language down to gates. This way, they will be enable			•
	performance and to propose feasible options.	ed to evaluate the impact that these to	w aboutdoubli levelo ii	ave on an entire systems
	portornarios and to propose todolore options.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group and	to present the results accordingly.		
Autonomy	Students are able to acquire new knowledge from specific literature	and to associate this knowledge with	other classes.	
		•		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points Examination	6 Written exam			
Examination duration and scale	90 minutes, contents of course and labs	o: Compulsory		
Assignment for the Following	General Engineering Science (German program): Core qualification	i. Compulsory		
Curricula	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory	: Compulsory		
	General Engineering Science (English program): Core qualification			
	Computational Science and Engineering: Core qualification: Comp Mechatronics: Core qualification: Compulsory	uisory		
	Technomathematics: Specialisation Informatics: Elective Compulso	rv.		
	recimomatifematics, opecialisation informatics, Elective Compulso	· y		

Course L0321: Computer Engineering	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	1. Introduction
	 Principles of digital design Analog versus Digital Gates and flip-flops Aspects of digital design Integrated cicuits Digital devices Time-to-market
	2. Number Systems and Codes General positional number systems Representation of numbers Binary arithmetic



- Number and character codes
- · Codes for detecting and correcting errors
- Codes for serial data transmission
- · Binary prefixes

3. Digital Circuits

- · Logic signals and gates
- Logic families
- CMOS logic
- CMOS circuits: electrical behavior
- CMOS input and output structures
- Bipolar logic
- CMOS logic families
- CMOS/TLL interfacing

4. Combinational Logic Design (Principles)

- · Switching algebra
- Combinational-circuit analysis
- Combinational-circuit synthesis
- Minimization
- Timing hazards

5. Combinational Logic Design (Practices)

- · Documentation standards
- . Timing of digital circuits
- Decoders and encoders
- Three-state devices
- Multiplexers and demultiplexers
- Exclusive-OR gates and parity circuits
- Comparators
- Adders and subtractors
- Combinational multiplier
- Barrel shifter
- Arithmetic and logic unit (ALU)

6. Sequential Logic Design (Principles)

- State concept and clock signal
- Bistable elements
- Asynchronous latches
- Synchronous latches
- Synchronous flip-flops
- Overview: latches and flip-flops
- Clocked synchronous state-machine analysis
- Clocked synchronous state-machine design
- Designing state machines using state diagrams
- Sequential-circuit design with VHDL
- Decomposing state machines

7. Sequential Logic Design (Practices)

- Sequential-circuit documentation standards
- Latches and flip-flops
- Counters
- Shift registers
- Iterative versus sequential circuits
- Synchronous design methodology
- Impediments to synchronous design

8. Memory, PLDs, CPLDs und FPGAs

- ROM, SRAM, DRAM, SDRAM
- Programmable logic devices (PLDs)
- Complex programmable logic devices (CPLDs)
- Field-programmable gate arrays (FPGAs)

9. Microprocessor Technology (Principles)

- Computer history
- Von Neumann architecture
- Components of a microprocessor system



Literature	
	S. Voigt, Skript zur Vorlesung "Technische Informatik"
	 J. Wakerly, Digital Design: Principles and Practices, 4. Auflage, 2010, Pearson Prentice Hall, ISBN: 978-0-13-613987-4
	 D. Hoffmann, Grundlagen der Technischen Informatik, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9

	 J. Wakerry, Digital Design: Principles and Practices, 4. Aulitage, 2010, Pearson Prentice Hair, ISBN: 978-0-13-613967-4 D. Hoffmann, Grundlagen der Technischen Informatik, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9 		
Course L0324: Computer Engineering			
Hrs/wk			
CP Workload in Hours	2 Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	1. Introduction		
	Principles of digital design		
	Analog versus Digital		
	Gates and flip-flops		
	Aspects of digital design Advanted digital design The control of the contr		
	Integrated cicuitsDigital devices		
	• Time-to-market		
	2. Number Systems and Codes		
	General positional number systems		
	Representation of numbers Ringry grithmetics		
	Binary arithmetic Number and character codes		
	Codes for detecting and correcting errors		
	Codes for serial data transmission		
	Binary prefixes		
	3. Digital Circuits		
	Logic signals and gates		
	Logic families		
	CMOS logic		
	CMOS circuits: electrical behavior		
	CMOS input and output structures Bipolar logic		
	CMOS logic families		
	CMOS/TLL interfacing		
	4. Combinational Logic Design (Principles)		
	Switching algebra		
	Combinational-circuit analysis		
	Combinational-circuit synthesis		
	Minimization Timing borough		
	Timing hazards		
	5. Combinational Logic Design (Practices)		
	Documentation standards		
	Timing of digital circuits		
	Decoders and encoders		
	Three-state devices Multiple or and demultiple or an analysis of the state		
	Multiplexers and demultiplexers Exclusive-OR gates and parity circuits		
	Comparators		
	Adders and subtractors		
	Combinational multiplier		
	Barrel shifter Address to and large unit (ALII)		
	Arithmetic and logic unit (ALU)		
	6. Sequential Logic Design (Principles)		
	State concept and clock signal		
	Bistable elements		
	Asynchronous latches Synchronous latches		
	Synchronous latches Synchronous flip flops		

Synchronous flip-flops

• S. Voigt, Skript zur Vorlesung "Technische Informatik"

Literature



Overview: latches and flip-flops
Clocked synchronous state-machine analysis
Clocked synchronous state-machine design
Designing state machines using state diagrams
Sequential-circuit design with VHDL
Decomposing state machines
7. Sequential Logic Design (Practices)
Sequential-circuit documentation standards
Latches and flip-flops
Counters
Shift registers
Iterative versus sequential circuits
Synchronous design methodology
Impediments to synchronous design
8. Memory, PLDs, CPLDs und FPGAs
ROM, SRAM, DRAM, SDRAM
Programmable logic devices (PLDs)
Complex programmable logic devices (CPLDs)
Field-programmable gate arrays (FPGAs)
9. Microprocessor Technology (Principles)
Computer history
Von Neumann architecture
Components of a microprocessor system

J. Wakerly, Digital Design: Principles and Practices, 4. Auflage, 2010, Pearson Prentice Hall, ISBN: 978-0-13-613987-4
 D. Hoffmann, Grundlagen der Technischen Informatik, 2. Auflage, 2010, Carl Hanser Verlag, ISBN: 978-3-446-42150-9



Module M0853: Mathematics III				
Courses				
Title		Tun	Unabuk	СР
		Тур	Hrs/wk	
Analysis III (L1028)		Lecture	2	2
Analysis III (L1029)		Recitation Section (small)	1	1
Analysis III (L1030)	#=1 F==== \	Recitation Section (large)	1	1
Differential Equations 1 (Ordinary Differen		Lecture	2	2
Differential Equations 1 (Ordinary Differen		Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differen		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous Knowledge	Mathematics I + II			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	7 mor taking part outdood and 1, state mare reading	. the following focusing focus		
Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using apprexamples. Students can discuss logical connections between these concepts. They are capable of 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 the concepts studied in this course. they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. Personal Competence Social Competence Students are able to work together in teams. They are capable to use mathematics as a common language. In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design excheck and deepen the understanding of their peers.				
			can design examples to	
 Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 				
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points	8			
Examination	Written exam			
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations	1)		
Assignment for the Following				
Curricula				
Curricula				
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Core qualification: Compulsory			
	Computational Science and Engineering: Core qualification: Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsor	v		
	1	,		



Course L1028: Analysis III				
Тур	Lecture			
Hrs/wk	2			
CP				
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28			
Lecturer	Dozenten des Fachbereiches Mathematik der UHH			
Language	DE			
Cycle	WiSe			
Content	Main features of differential and integrational calculus of several variables			
Liberatura	 Differential calculus for several variables Mean value theorems and Taylor's theorem Maximum and minimum values Implicit functions Minimization under equality constraints Newton's method for multiple variables Double integrals over general regions Line and surface integrals Theorems of Gauß and Stokes 			
Literature	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000. 			

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

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

Course L1031: Differential Equations 1 (Ordinary Differential Equations)				
	ecture			
Hrs/wk				
CP				
Workload in Hours	ependent 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	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 H.J. Oberle, K. Rothe, Th. Sonar: Mathematik für Ingenieure, Band 3: Aufgaben und Lösungen; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000. 			



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

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



Courses			
itle	Typ Hrs/wk CP Lecture 2 4		
atroduction to Control Systems (L0654) atroduction to Control Systems (L0655)	Lecture 2 4 Recitation Section (small) 2 2		
Module Responsible			
Admission Requirements			
Recommended Previous			
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Children and the second state of the second		
	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and secon systems 		
	They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus		
	They can explain the dynamics or simple contain topic and margines drived from it. They can explain the Nyquist stability criterion and the stability margins derived from it.		
	They can explain the role of the phase margin in analysis and synthesis of control loops		
	They can explain the way a PID controller affects a control loop in terms of its frequency response		
	They can explain issues arising when controllers designed in continuous time domain are implemented digitally		
OL III.			
Skills	Students can transform models of linear dynamic systems from time to frequency domain and vice versa		
	They can simulate and assess the behavior of systems and control loops		
	They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules		
	They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques		
	They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation		
	They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks		
Personal Competence			
Social Competence			
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving		
	problems.		
	The second state of the Second Level Second		
	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		
Workload in Hours	urs Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Examination	Written exam		
Examination duration and scale	120 min		
	g General Engineering Science (German program): Core qualification: Compulsory		
Assignment for the Following	General Engineering Science (German program): Core qualification: Compulsory		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: 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 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		
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	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 Benery 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 Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in 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 Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory		
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	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 Science (Incompulsory General Engineering Science (Incompulsory Semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (Incompulsory Science) German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Procompulsory General Engineering Science (Incompulsory Semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 seme		
	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 Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Procompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Procompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Com		
	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 Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Proc Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Proc Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Com		
	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 Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Procompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Procompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Com		



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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Process Engineering: Core qualification: Compulsory

Тур	Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	Signals and systems		
	Linear systems, differential equations and transfer functions The decrease of advanced and accordance of the state o		
	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		
	Double of the Control		
	Root locus techniques		
	Root locus plots		
	Root locus design of PID controllers		
	quency 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		
	ne delay systems		
	Root locus and fragulancy response of time delay systems		
	 Root locus and frequency response of time delay systems Smith predictor 		
	Digital control		
	Sampled-data systems, difference equations		
	Tustin approximation, digital implementation of PID controllers		
	Software tools		
	Introduction to Matlab, Simulink, Control toolbox		
	Computer-based exercises throughout the course		
Literature	Werner, H., Lecture Notes "Introduction to Control Systems"		
	 werner, H., Lecture Notes "introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 		
	K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010		
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010		



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



Specialization Civil- and Environmental Engeneering

Module M0740: Structural A	Analysis I			
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Courses				
Title		Тур	Hrs/wk	CP
Structural Analysis I (L0666)		Lecture	2	3
Structural Analysis I (L0667)		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements				
	none			
Recommended Previous	Mechanics I, Mathematics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence	The alling part observed, part of the state	,		
Knowledge	After successfully completing this module, students can express the basic	asnacts of linear frame analysis of stat	ically determinate	evetame
Knowledge	After successionly completing this module, students can express the basic of	aspects of life at fairle attaiys of state	ically determinate	systems.
Skills	After successful completion of this module, the students are able to distinable to analyze state variables and to construct influence lines of statically	•		•
Personal Competence Social Competence Autonomy The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress the lecture period, already.			arning progress during	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and	Enviromental Engeneering: Compuls	sory	
Curricula	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	Environmental Engeneering: Compuls	ory	
	Technomathematics: Specialisation Engineering Science: Elective Compu	llsory		
·	<u> </u>			·

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



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



Module M0613: Reinforced	Concrete I			
Courses				
Title		Тур	Hrs/wk	CP
Project Seminar Concrete I (L0896)		Seminar	1	2
Reinforced Concrete Design I (L0303)		Lecture	2	2
Reinforced Concrete Design I (L0305)		Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	none			
Recommended Previous	Basic knowledge in structural analysis and building	ı materials.		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students can outline the history of concrete c	onstruction and explain the basics of structural engin	eering, including usua	al load combinations and
-	safety concepts. They are able to draft and dime	nsion simple structures, as well as to evaluate and	discuss the behaviou	r of the materials and of
	structural members.	,		
Skills	The students are able to apply basic procedures	of the conception and dimensioning to practical cas	ses. They are capable	to draft simple concrete
		iding with axial force, and to plan their detailing and e		·
	construction sketches and draw up technical descri			.,
Personal Competence				
Social Competence				
· ·	The students are able to carry out simple tasks in the	e conception and dimensioning of structures and to cr	itically reflect the resul	ts.
a.o.nomy	care and and to daily dutomple table in a			
Workload in Hours	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): 5	Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	Civil- and Environmental Engineering: Core qualifie	cation: Compulsory		
	General Engineering Science (English program): S	pecialisation Civil- and Enviromental Engeneering: Co	ompulsory	

Course L0896: Project Seminar Concrete I	
Тур	Seminar
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	In the course of the project seminar, a simple structure is drafted and dimensioned.
Literature	



Course L0303: Reinforced Concrete Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	The following subjects/contents are treated:
Literature	history of concrete construction mechanical and physical-chemical properties od concrete and steel bond between concrete and reinforcement concepts for dimensioning, limit state models, structural safety design of linear members for tension and bending with and without axial force Description:
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!

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



Module M0672: Signals and	d Systems			
•				
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3 1	4 2
Signals and Systems (L0433)	Der Control Dent	Recitation Section (large)	ı	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste		•	•
Knowledge	Further experience with spectral transformations (Fourier series,	Fourier transform, Laplace transform) is	useful but not required.	
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linea	r time-invariant (LTI) systems using meth	nods of signal and syst	em theory. They are at
	to apply the fundamental transformations of continuous-time and	discrete-time signals and systems. They	can describe and ana	lyse deterministic signa
	and systems mathematically in both time and image domain. I	n particular, they understand the effects	in time domain and i	image domain which a
	caused by the transition of a continuous-time signal to a discrete	time signal.		
Skills	The students are able to describe and analyse deterministic sign	nals and linear time-invariant systems u	sing methods of signal	and system theory. Th
	can analyse and design basic systems regarding important prop	erties such as magnitude and phase re	sponse, stability, linea	rity etc They can asse
	the impact of LTI systems on the signal properties in time and fre-	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	opriate literature sources. They can con	ntrol their level of know	vledge during the lectu
	period by solving tutorial problems, software tools, clicker system			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	Computer Science and Engineering: Co	mpulsory	
	General Engineering Science (German program): Specialisation	Chemical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Civil- and Enviromental Engeneering: C	ompulsory	
	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulsory		
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation		ompulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor	npuisory		
	Mechatronics: Core qualification: Compulsory	Commission .		
	Technomathematics: Specialisation Engineering Science: Elective	re Compulsory		



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

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



Module M0706: Geotechnic	sl			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L1493)		Problem-based Learning	2	2
Soil Mechanics (L0551)		Recitation Section (large)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Mechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	The students know the basics of soil mechanics as the	structure and characteristics of soil, stress d	istribution due to we	eight, water or structures
	consolidation and settlement calculations, as well as failure	of the soil due to ground- or slope failure.		
Skills	After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of			
	geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight or influence of structures. They are are able to prove			
	the usability (settlements) for shallow foundations.			
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialis	ation Civil- and Enviromental Engeneering: Co	mpulsory	•
Curricula	Civil- and Environmental Engineering: Core qualification: C	ompulsory		
	General Engineering Science (English program): Specialisa	ation Civil- and Enviromental Engeneering: Co	mpulsory	

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

Course L1493: Soil Mechanics	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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



Module M0744: Structural	Analysis II			
Courses				
Title		Тур	Hrs/wk	CP
Structural Analysis II (L0673)		Lecture	2	3
Structural Analysis II (L0674)		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I/II			
Knowledge	Mathematics I/II			
	Differential Equations I			
	Structural Analysis I			
	,			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	,,	<u> </u>		
Knowledge	After successful completion of this module, students can expr	ess the basic aspects of linear frame analysis	of statically indetermi	nate systems.
r.i.e.meage	The cooles and completion of the module, state in each exp.	ood the basic aspeste of misal mame analysis	or ordination in a distribution in	nato oyotomo.
Skills	After successful completion of this module, the students are a	ble to analyze state variables and to construct	influence lines of sta	tically inderminate plane
	and spatial frame and truss structures.			
Personal Competence				
Social Competence				
Autonomy	The students are able to work in-term homework assignment	ents. Due to the in-term feedback, they are e	nabled to self-assess	their learning progress
	during the lecture period, already.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Civil- and Enviromental Engeneering: Cor	npulsory	
Curricula	Civil- and Environmental Engineering: Core qualification: Co		/	
7	General Engineering Science (English program): Specialisat		npulsory	
			ry	

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

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



	ns of Management			
Courses				
ïtle		Тур	Hrs/wk	СР
ntroduction to Management (L0880)		Lecture	4	4
roject Entrepreneurship (L0882)	Dut Object Hill	Problem-based Learning	2	2
Module Responsible	Prof. Christoph Ihl			
Admission Requirements Recommended Previous	None Basic Knowledge of Mathematics and Business			
Knowledge	basic Knowledge of Mathematics and business			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence	3,,	3 3		
Knowledge	After taking this module, students know the important basics o Marketing and Innovation, and also to Investment and Controllii		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Manag field of Management explain the most important aspects of and goals in Management			
	describe and explain basic business functions as proc ressource management, information management, inno explain the relevance of planning and decision makin	vation management and marketing		
	some basic methods from mathematical Finance state basics from accounting and costing and selected c	ontrolling methods.		
Skills	Students are able to analyse business units with respect Entrepreneurship project in a team. In particular, they are able to		ctives, strategies etc) and to carry out a
	analyse Management goals and structure them appropri	ately		
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple object			
	analyse production and procurement systems and Busin analyse and apply basic methods of marketing	less information systems		
	select and apply basic methods from mathematical finar	ce to predefined problems		
	apply basic methods from accounting, costing and contri			
Personal Competence Social Competence	Students are able to			
	work successfully in a team of students			
	to apply their knowledge from the lecture to an entrepret	neurship project and write a coherent report	on the project	
	to communicate appropriately and		. от то реојосе	
	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 96, Study Time in Lecture 84			
Credit points				
Examination				
Examination duration and scale	90 Minuten			
Assignment for the Following		n Electrical Engineering: Compulsory		
		n Computer Science and Engineering: Com	pulsory	
Curricula	General Engineering Science (German program): Specialisatio			
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co	, ,	
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co	, ,	
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio General Engineering Science (German program): Specialisatio	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio Civil- and Environmental Engineering: Core qualification: Comp	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio Civil- and Environmental Engineering: Core qualification: Complisory	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory pulsory	, ,	
Curricula	General Engineering Science (German program): Specialisatio Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Core General Engineering Science (English program): Specialisation	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory bulsory mpulsory n Civil- and Enviromental Engeneering: Cor	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Core General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory bulsory mpulsory n Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Core General Engineering Science (English program): Specialisation	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory pulsory n Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory n Electrical Engineering: Compulsory	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Congulsory Energy and Environmental Engineering: Core qualification: Congulsory Energy Engineering Science (English program): Specialisation General	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory sulsory n Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory a Electrical Engineering: Compulsory n Energy and Enviromental Engineering: Cor	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Congeneral Engineering Science (English program): Specialisation General Enginee	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory sulsory n Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory n Electrical Engineering: Compulsory n Energy and Enviromental Engineering: Cor n Computer Science and Engineering: Com	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Congeneral Engineering Science (English program): Specialisation General Enginee	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory n Usery n Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory n Electrical Engineering: Compulsory n Energy and Enviromental Engineering: Cor n Computer Science and Engineering: Com n Mechanical Engineering: Compulsory	mpulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Congeneral Engineering Science (English program): Specialisation General Enginee	n Bioprocess Engineering: Compulsory n Energy and Enviromental Engineering: Co n Civil- and Enviromental Engeneering: Co n Mechanical Engineering: Compulsory n Biomedical Engineering: Compulsory n Naval Architecture: Compulsory n University of Civil- and Enviromental Engeneering: Cor n Bioprocess Engineering: Compulsory of Electrical Engineering: Compulsory of Computer Science and Engineering: Com of Mechanical Engineering: Compulsory of Mechanical Engineering: Compulsory of Biomedical Engineering: Compulsory	mpulsory	



Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory

Course L0880: Introduction to Mana	gement
Тур	Lecture
Hrs/wk	4
СР	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process
	Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,
	using their knowledge from the corresponding lecture.
	Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0580: Principles of	of Building Materials and Building	Physics		
		, 0.00		
Courses				
ïtle		Тур	Hrs/wk	CP
uilding Physics (L0217)		Lecture	2	2
uilding Physics (L0219)		Recitation Section (large)	1	1
uilding Physics (L0247)		Recitation Section (small)	1	1
rinciples of Building Materials (L0215)		Lecture	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Knowledge of physics, chemistry and mathema	atics from school		
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processed and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.			
Skills	The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.			
Personal Competence				
Social Competence	The students are able to support each other to	learn the very extensive specialist knowledge.		
Autonomy	The students are able to make the timing and t	the operation steps to learn the specialist knowledge of a	very extensive field.	
Workload in Hours	Independent Study Time 96, Study Time in Lec	cture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 stündige Klausur			
Assignment for the Following	General Engineering Science (German progra	m): Specialisation Civil- and Enviromental Engeneering	: Compulsory	
Curricula	General Engineering Science (German progra	nm, 7 semester): Specialisation Civil Engineering: Compu	ulsory	
	Civil- and Environmental Engineering: Core qu	ualification: Compulsory		
		m): Specialisation Civil- and Enviromental Engeneering:	Compulsory	
		m, 7 semester): Specialisation Civil Engineering: Compu		
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Course L0217: Building Physics	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport,
	condensation moisture, protection against mold, fire protection,
	noise protection
Literature	Fischer, HM.; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag,
	Wiesbaden, ISBN 978-3-519-55014-3

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



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

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



Module M0611: Steel Struct	tures I			
Courses				
Title		Тур	Hrs/wk	CP
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Dr. Jürgen Priebe			
Admission Requirements	none			
Recommended Previous	Structural analysis I, Structural analysis II			
Knowledge	Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	Principles of Building Materials and Building Physics			
	Finiciples of building waterials and building Physics			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	After passing this module students are able to			
	give a summary of the security concept			
	explain the priciples of the design process			
	describe and illustrate the bhaviour of memers in tension	compression and bending		
Skills	Students can rate and apply the material steel appropiately with respect to its properties and usage.			
	They can use the security concept with respect to loads, forces a	nd resistances.		
	They can check the ultimate limit state and the serviceability of si	mple members in tension, compression an	d bending.	
Personal Competence				
Social Competence	After participation of an optional course (building of a simple tru	iss) they are able to organize themselves	in groups. They will	be successful in guided
	building a truss with bolted connections according to design draw			
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation	Civil- and Enviromental Engeneering: Cor	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Sp	ecialisation Civil Engineering: Compulsor	у	
	Civil- and Environmental Engineering: Core qualification: Compu	llsory		
	General Engineering Science (English program): Specialisation	Civil- and Enviromental Engeneering: Con	npulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Civil Engineering: Compulsory	/	

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



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



Module M0631: Concrete S	tructures II			
Courses				
Title		Тур	Hrs/wk	CP
Project Concrete Structures II (L0894)		Project Seminar	1	1
Concrete Structures II (L0348)		Lecture	3	4
Concrete Structures II (L0349)		Recitation Section (large)	1	1
Module Responsible	Prof. Günter Rombach			
Admission Requirements	none			
Recommended Previous	- Keep lades of lands and sales and sales after the sales			
Knowledge	Knowledge of loads on structures and combination of actions			
	Basics of safety format are required.			
	Knowledge in design of beams and columns for ultimate limit state			
	Lecture 'Concrete Structures I'			
Educational Objections	After telice and according to the depth bearing and the fellowing larger			
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students know the basic principles which arev required for design of reinforced concrete structures. They know the various methods to estimate the			
	member forces in simple one and two-way slabs.			
Skills	The students can design reinforced concrete structure in the ultimate.	ate limit state (shear, bending, to	rsion) and in the servi	ceability limit state (crack
	 The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.). 			
	The students can estimate the member forces of simple slabs.			
	The students know the content and the layout of a structural analys	sis		
	The diagona line is an analysis and an anyon and an analysis			
Personal Competence				
Social Competence	Cooperation in a project work, where they design in a team a real concrete	e building and present the results	s at the end.	
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and	d Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Specialisat	tion Civil Engineering: Elective Co	ompulsory	
	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	d Enviromental Engeneering: Cor	mpulsory	
	General Engineering Science (English program, 7 semester): Specialisati			
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Course L0894: Project Concrete Structures II		
Тур	Project Seminar	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	Design of a truss structure	
Literature	Skript zur Lehrveranstaltung "Stahlbetonbau II"	



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

Course L0349: Concrete Structures II		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0755: Geotechnic	es II			
Courses				
Title		Тур	Hrs/wk	CP
Foundation Engineering (L0552)		Lecture	2	2
Foundation Engineering (L0553)		Recitation Section (large)	2	2
Foundation Engineering (L1494)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Modules:			
Knowledge	- Markey Land III			
	Mechanics I-II Outside in I			
	Geotechnics I			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know the basic principles and methods which are required to verificate the stability of geotechnical structures.			
Skills	After successful completion of the module the students are able to:			
	 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	84		
Credit points	6		<u> </u>	
Examination	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following	General Engineering Science (German program):	Specialisation Civil- and Enviromental Engeneering: C	ompulsory	
Curricula	General Engineering Science (German program, 7	semester): Specialisation Civil Engineering: Elective (Compulsory	
	Civil- and Environmental Engineering: Core qualifi			
	General Engineering Science (English program): S	Specialisation Civil- and Enviromental Engeneering: Co	ompulsory	
	General Engineering Science (English program, 7	competer): Specialisation Civil Engineering: Elective C	'ompulcon/	

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

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



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



Module M0728: Hydraulic E	ngineering I			
Courses				
Title		Тур	Hrs/wk	CP
Hydrology (L0909)		Lecture	1115/WK	1
Hydrology (L0956)		Problem-based Learning	1	2
Hydromechanics (L0615)		Lecture	2	2
Hydromechanics (L0616)		Recitation Section (large)	1	1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Mathematics I, II and III			
Knowledge	Mechanik I und II			
Educational Objectives	After taking part successfully, students have reached the following learnin	g results		
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.			
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 Autonomy	The students are able to prepare and present technical presentations for students can provide each other with feedback and suggestions on the strategy on an individual basis.		reflecting their study	techniques and learning
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 2 hours. The examination includes calculations tasks.	tasks with respect to the gener	al understanding of	the lecture contents and
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- an	d Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester): Specialisat	-		
2.3.10	Civil- and Environmental Engineering: Core qualification: Compulsory	3 - xg xpaiooi	•	
	General Engineering Science (English program): Specialisation Civil-and	Henviromental Engeneering: Con	mnulsory	
	General Engineering Science (English program, 7 semester): Specialisation			
	deneral Engineering Science (English program, 7 semester). Specialisati	on own Engineering. Compulsor	у	

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



Course L0956: Hydrology		
Тур	Problem-based Learning	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

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



Module M0869: Hydraulic E	ingineering II			
Courses				
Title		Тур	Hrs/wk	CP
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L0959)	Lecture 2 2			2
Hydraulic Engineering (L0960)		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous	Hydraulik Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engin	neering and hydraulics. They are able to e	xplain the applicatio	n of basic hydrodynamic
	formulations (conservation laws) to practical hydraulic engin	eering problems. Besides this, the studer	ts can illustrate imp	ortant tasks of hydraulic
	engineering and give an overview over river engineering, flood	protection, hydraulic power engineering an	d waterways engine	ering.
Skills	The students are able to apply hydraulic engineering methods			
	systems. Besides this, they are able to use and apply establish	• • •	water surfaces of ch	annel flows, influences of
	constructions (weirs, etc.) on channel flows as well as flow cond	ditions of pipe system.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 2 hours. The examination	n includes tasks with respect to the gener	al understanding of	the lecture contents and
	calculations tasks.			
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Civil- and Enviromental Engeneering: Co	mpulsory	
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Civil Engineering: Elective Co	ompulsory	
	Civil- and Environmental Engineering: Core qualification: Com	pulsory	•	
	General Engineering Science (English program): Specialisation	•	npulsory	
	General Engineering Science (English program, 7 semester): S	Specialisation Civil Engineering: Elective Co	mpulsory	
			· ,	

Course L0957: Hydraulics	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



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

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



Module M0686: Sanitary En	gineering			
Courses				
Title Wastewater Disposal (L0276)		Typ Lecture	Hrs/wk	CP 2
Wastewater Disposal (L0278)		Recitation Section (large)	1	1
Drinking Water Supply (L0306)		Lecture	2	1
Drinking Water Supply (L0308)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	none			
Recommended Previous	Basic knowledge on Chemistry and Biology			
Knowledge	Hydraulics of pipe systems and open channels			
		auglity.		
	Basic knowledge on water management: water quantity and water or	quanty		
	Basic knowledge on Environmental Legislation: Federal Water Act			
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	The students can examplify their expert knowledge on urban water infrastru	uctures. They can present the derivation	on and detailed ex	planation of important
	standards for the design of drinking water supply and wastewater dispo	osal systems in Germany and they a	re capable of rep	roducing the relevant
	empiricals assumptions and scientific simplifications. The students are able	e to present and discuss sanitary engir	neering processes	and the technologies
	used for drinking and wastewater treatment. They can also assess existin	g problems in the field of sanitary eng	gineering by consi	idering legal, risk and
	saftey aspects. Furthermore, they know how to draft the features and ef	fectiveness of important technologie	s of the future su	ch as high- and low-
	pressure membrane filtration systems and techniques for the removal of tra	ce pollutants.		
Skills	The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence				
Social Competence	Students are able to form concepts on their own to optimize urban water	•		ppropriate knowledge
	when being given some clues or information with regard to the approach to	problems (preparation and ioliow-up	or the exercises).	
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Civil- and		-	
Curricula	General Engineering Science (German program, 7 semester): Specialisation	on Civil Engineering: Elective Compuls	sory	
	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and		•	
	General Engineering Science (English program, 7 semester): Specialisatio	n Civil Engineering: Elective Compuls	ory	



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

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



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

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



Specialization Energy and Environmental Engineering

Forms of energy are used in a variety of ways in industry, domestic households and transportation, so energy is now as important a part of our daily lives as water. Increasingly, attention is paid to sustainable use of energy, without imposing long-term strains on coming generations. Cross-linked training in the foundations of and current issues around energy technology takes account of this situation. One increasingly important concern is to reduce CO₂ emissions responsible for the greenhouse effect. In pursuit of this, energy-saving opportunities are pursued and increasing use is made of regenerative energies. Though fossil fuels will still have to be used for a long time to come, efforts are made to reduce CO₂ emissions by increasing efficiency and by capturing the CO₂ their use generates and storing it underground. These processes in particular make it essential for energy engineering and environmental engineering activities to be closely linked.

Module M0598: Mechanica	Engineering: Design			
Courses				
Title		Тур	Hrs/wk	СР
imbodiment Design and 3D-CAD (L0268)		Lecture	2	1
lechanical Design Project I (L0695)		Practical Course	3	2
lechanical Design Project II (L0592)		Practical Course	3	2
eam Project Design Methodology (L0267	7)	Problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	 explain design guidelines for machinery parts e.g. con 	sidering load cituation, materials and manu-	facturing requirements	
	 explain design guidelines for machinery parts e.g. con describe basics of 3D CAD, 	isiacimy load situation, materials and manu	acaming requirements	'9
	 explain basics methods of engineering designing. 			
	explain basics methods of engineering designing.			
Skills	After passing the module, students are able to:			
	independently create sketches, technical drawings an	d documentations e.g. using 3D CAD		
	design components based on design guidelines autor			
	 dimension (calculate) used components, 	iomodoly,		
	use methods to design and solve engineering design	tasks systamtically and solution-oriented		
	apply creativity techniques in teams.			
	THE STATE OF THE S			
Personal Competence				
Social Competence	After passing the module, students are able to:			
	 develop and evaluate solutions in groups including ma 	aking and documenting decisions		
	moderate the use of scientific methods,	aning and documenting document,		
	 present and discuss solutions and technical drawings 	within groups.		
	reflect the own results in the work groups of the course			
	Tollook the currection in the field groupe of the course	•		
Autonomy	Students are able			
	 to estimate their level of knowledge using activating r 	nethods within the lectures (e.g. with clickers	3)	
	To solve engineering design tasks systematically.	nounced main the rectarge (e.g. mar energy	5);	
	10 controlling dough data of community.			
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points				
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specialisat		Compulsory	
Curricula	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisat			
	Energy and Environmental Engineering: Core qualification: C			
	General Engineering Science (English program): Specialisati		Compulsory	
	General Engineering Science (English program): Specialisati			
	General Engineering Science (English program): Specialisati	on Biomedical Engineering: Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



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

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



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

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



Module M0957: Introductio	n into Energy and Environmental Engi	neering			
Courses					
Title		Тур		Hrs/wk	CP
Introduction to Energy and Environmental	Engineering (L0212)	Problem-based L	earning	4	3
Physics-Lab for VT/ BVT/ EUT (L0947)	3 3(-)	Laboratory Cours	-	2	3
Module Responsible	Prof. Alfons Kather				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students can sketch the different options for ele to name the main components of the correspond		-	-	
	thematically specialised context.				
	Through a practical course in physics the students le	arn to deliver an overview of specialist	aspects of physics		
Skills	Within the framework of the module the students lear	n the fundamentals of technical commu	nication. In the Semir	nar the	
	students learn to use oral communication for spec	ialist themes. In the ractical course in	Physics they deepe	n their knowled	dge from school physics
	through individual experiments with learn demonstra	tors. The students thus learn in addition	n written technical con	nmunication sk	ills.
Personal Competence	The control of the other state of the state	the state of the s	the control of the co	and the second state of the	
Social Competence	The social skills of the students within the group but		thened. For the prepa	ration of the jo	int
	Seminar presentation the students learn communica	tion and team skills.			
	The practical course in Physics is also carried out in	groups, including the preparation of the	test reports. The stud	lents strengthe	n
	further their social skills, can achieve in group comm	on results and report them in joint proto	cols.		
Autonomy	In the Seminar the students learn individually to form				and to
	preparation and delivery of the individual presentation present these to the group. The students learn with	·		•	
	individually prepare and present a short experimenta	·	se on Filysics to per	ioiiii experiiiie	iliai demonstrations and
	marvidually propare and prosent a short experiment	a report.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4			
Credit points	6				
Examination	Presentation				
Examination duration and scale	EEUT: Compulsory attendance and seminar incl. d	iscussion; Physics Lab: error calculation	on seminar; 6 Experi	ments with: int	rod. seminar (20 min), 4
	handwritten pages preparatory script, transcript on the	eir own and attestation; 10min short tall	k; 1 p. handout		
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Energy and Enviromental E	Engineering: Compul	sory	
Curricula	Energy and Environmental Engineering: Core qualif				
	General Engineering Science (English program): Sp	ecialisation Energy and Enviromental E	ingineering: Compuls	ory	

Course L0212: Introduction to Energ	yy and Environmental Engineering
Тур	Problem-based Learning
Hrs/wk	4
CP	3
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	The students are divided in groups and each group visits a company from Hamburg which is active on the field of energy and environmental
	technology. The topics and technologies covered during the visits are then presented in Seminars. Where appropriate, the Seminars will be
	supplemented by lectures given by professors of the TUHH.
	Some sample topics are:
	come sample opiocare.
	Conventional steam power plants and combined cycle power plants
	Power plant components (boiler, steam turbine, condenser, feed water heaters, etc.)
	Distributed electricity generation and energy supply
	District and neighbourhood heating networks
	Renewable energy
	Energy storage The side of the state o
	Electric grids
	Energy management at end-user level Energy-intensive industries
	Environmental technology (e.g., wastewater treatment plants)
	Environmental technology (e.g., wastewater treatment plants)
Literature	Keine erforderlich



Course L0947: Physics-Lab for VT/	BVT/ EUT
Тур	Laboratory Course
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hansen
Language	DE/EN
Cycle	WiSe
Content	In the physics lab a number of key experiments on physical phenomena in mechanics, oscillatory and wave motion, thermodynamics, electricity, and optics will be conducted by the students under assistance of a lecturing tutor. The experiments are part of the physics education program presented in
	the course "Physics for TUHH-VT Engineers".
	Beyond teaching of fundamental physical background the objectives are basic skills in preparation and performing physical measurements, usage of physical equipment, analysis of the results and preparation of a report on the experimental data.
Literature	Zu den Versuchen gibt es individuelle Versuchsanleitungen, die vor der Versuchsdurchführung ausgegeben werden.
	Zum Teil müssen die zur Versuchsdurchführung notwendigen physikalischen Hintergründe selbstständig erarbeitet werden, wozu die zur Vorlesung "Physik für TUHH-VT Ingenieure" angegebene Literatur gut geeignet ist.



Module M0536: Fundamen	tals of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Fluid Mechanics (L0091		Lecture	2	4
Exercises in Fluid Mechanics for Process		Recitation Section (large)	1	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous				
Knowledge	Working with force balances			
	Simplification and solving of partial differential equations			
	Integration			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
Knowledge	Students are able to:			
	explain the difference between different types of flow			
	give an overview for different applications of the Reynolds	s Transport-Theorem in process enginee	rina	
	explain simplifications of the Continuity- and Navier-Stoke			
	, , , , , , , , , , , , , , , , , , ,	, , , , , , , , , , , , , , , , , , ,		
Skills	The students are able to			
	describe and model incompressible flows mathematically			
	reduce the governing equations of fluid mechanics by sin		ons e.g. by integration	
	notice the dependency between theory and technical approximation.		0 , 0	
	use the learned basics for fluid dynamical applications in	fields of process engineering		
Paranal Commetence				
Personal Competence Social Competence	The students			
Social Competence	THE Students			
	 are capable to gather information from subject related, pre 	ofessional publications and relate that inf	ormation to the contex	t of the lecture and
	able to work together on subject related tasks in small gro	oups. They are able to present their resul	ts effectively in English	n (e.g. during small group
	exercises)			
Autonomy	The students are able to			
,				
	search further literature for each topic and to expand their			
	work on their exercises by their own and to evaluate their	actual knowledge with the feedback.		
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation	Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Energy and Environmental Engineering: 0	Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Specialisation	Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	Energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (English program): Specialisation			
	Technomathematics: Specialisation Engineering Science: Elective	ve Compulsory		
	Process Engineering: Core qualification: Compulsory			



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

Course L0092: Exercises in Fluid Me	echanics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For
	this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems
	in Process Engineering.
Literature	Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
	2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
	3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
	 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
	5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
	6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
	7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
	8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
	9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008
	10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
	11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
	12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011



Module M0610: Electrical M	lachines			
Courses				
Title		Тур	Hrs/wk	CP
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals, of	differentials		
Knowledge	Desire of electrical accionaries and secological accionaries			
	Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principles of electric ar	nd magnetic fields.		
	They can describe the function of the standard types of electric made	shings and procent the corresponding	oquations and charact	orietio curvos
	They can describe the function of the standard types of electric mate	annes and present the corresponding	equations and charact	erisiic curves.
Skills	Students arw able to calculate two-dimensional electric and magne	tic fields in particular ferromagnetic ci	rouits with air gan. Fon	r this they annly the usual
Okino	methods of the design auf electric machines.	no notas in particular forformagnotic of	round with an gap. r opi	i tillo tiloy apply tilo addal
	mounded of the deeligh dan electric maximises.			
	They can calulate the operational performance of electric machines	s from their given characteristic data a	nd selected quantities	and characteristic curves.
	They apply the usual equivalent circuits and graphical methods.			
Personal Competence				
Social Competence				
Autonomy	Students are able independently to calculate electric and magna			
	performance of electric machines from the charactersitic data and t	ney thereof can calculate selected qua	antities and characterisi	tc curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation El	nergy and Environmental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation M	• •		
	Electrical Engineering: Core qualification: Elective Compulsory		•	
	Energy and Environmental Engineering: Core qualification: Compu	llsory		
	General Engineering Science (English program): Specialisation Er	ergy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program): Specialisation Me	echanical Engineering: Elective Comp	ulsory	
	Computational Science and Engineering: Specialisation Engineeri	ng Sciences: Elective Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Elective	e Compulsory		
	Mechanical Engineering: Core qualification: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory			



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

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



Module M0618: Renewable	s and Energy Systems			
Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Industry (L0	315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	With completion of this module, the students can provide	an overview of characteristics of energy syst	ems and their econd	mic efficiency. They can
	explain the issues occurring in this context. Furthermore, the	• • •		
	to subject-related contexts. The students can explain these			
	energy systems and critical discuss it.	approx,, are approximate toarr, errorg,	, -,,	,,
	onergy dystems and onestal disease in			
Skille	Students are able to apply methodologies for detailed de	termination of energy demand or energy pro	duction for various t	vnes of energy systems
OKIIIS	Furthermore, they can evaluate energy systems technica	**		
	Therefore, they can choose the necessary subject-specific can		-	certain given conditions.
	Therefore, they can choose the necessary subject-specific ca	alculation rules, also for flot standardized solut	lions of a problem.	
Personal Competence				
Social Competence				
Autonomy	Students can independently exploit sources, acquire the par	rticular knowledge about the subject area and	transform it to new gu	jestions.
			4	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	General Engineering Science (German program): Specialisa	ation Energy and Enviromental Engineering: C	ompulsory	
Curricula	Energy and Environmental Engineering: Core qualification:	Compulsory		
	General Engineering Science (English program): Specialisa	tion Energy and Enviromental Engineering: Co	ompulsory	
Credit points Examination Examination duration and scale Assignment for the Following	6 Written exam 3 hours written exam General Engineering Science (German program): Specialisa Energy and Environmental Engineering: Core qualification: (ation Energy and Enviromental Engineering: C	ompulsory	uestions.

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



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

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

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien – Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy – Technology, Economics and Environment; Springer, Berlin Heidelberg, 2007



Courses				
ïtle		Тур	Hrs/wk	CP
ntroduction to Management (L0880)		Lecture	4	4
roject Entrepreneurship (L0882)	Dut Object to	Problem-based Learning	2	2
Module Responsible	Prof. Christoph Ihl			
Admission Requirements Recommended Previous	None Basic Knowledge of Mathematics and Business			
Knowledge	Dasic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of Marketing and Innovation, and also to Investment and Controlling		nagement, from Planr	ning and Organisation
	explain the differences between Economics and Manager field of Management explain the most important aspects of and goals in Manager			
	describe and explain basic business functions as produ ressource management, information management, innova explain the relevance of planning and decision making	ation management and marketing		
	some basic methods from mathematical Finance state basics from accounting and costing and selected co	ntrolling methods.		
Skills	Students are able to analyse business units with respect Entrepreneurship project in a team. In particular, they are able to	to different criteria (organization, objec	tives, strategies etc.) and to carry out a
	analyse Management goals and structure them appropria	tely		
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objection.			
	analyse production and procurement systems and Busine analyse and apply basic methods of marketing.	ess information systems		
	 analyse and apply basic methods of marketing select and apply basic methods from mathematical finance 	e to predefined problems		
	apply basic methods from accounting, costing and control			
Personal Competence Social Competence	Students are able to			
	e work auggestally in a team of students			
	work successfully in a team of students to apply their knowledge from the lecture to an entreprene	ourship project and write a coherent report	on the project	
	to communicate appropriately and	and the project and write a control of report	on the project	
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination				
Examination duration and scale				
Assignment for the Following		Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation	Computer Science and Engineering: Com	pulsory	
Guiricula		Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co	,	
Guincua	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor	,	
Guincua	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory	,	
Guincua	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory	,	
Guincua	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	,	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compu	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	,	
Guincua	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	,	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compusion C	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Co Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	,	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	,	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory	mpulsory	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com	mpulsory	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation (General Engineering Science (English program): Specialisation (Gen	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com Bioprocess Engineering: Compulsory	npulsory	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation of General Engineering Scie	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com Bioprocess Engineering: Compulsory Electrical Engineering: Compulsory Energy and Enviromental Engineering: Co	npulsory	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation of General Engineering Scie	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com Bioprocess Engineering: Compulsory Electrical Engineering: Compulsory Energy and Enviromental Engineering: Com Computer Science and Engineering: Comp	npulsory	
Guincula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation of General Engineering Scie	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com Bioprocess Engineering: Compulsory Electrical Engineering: Compulsory Energy and Enviromental Engineering: Com Computer Science and Engineering: Com Mechanical Engineering: Compulsory	npulsory	
Curricula	General Engineering Science (German program): Specialisation Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation of General Engineering Scie	Bioprocess Engineering: Compulsory Energy and Enviromental Engineering: Cor Civil- and Enviromental Engeneering: Cor Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory Naval Architecture: Compulsory Ilsory pulsory Civil- and Enviromental Engeneering: Com Bioprocess Engineering: Compulsory Electrical Engineering: Compulsory Energy and Enviromental Engineering: Com Computer Science and Engineering: Com Mechanical Engineering: Compulsory Biomedical Engineering: Compulsory	npulsory	



Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory

Course L0880: Introduction to Mana	agement
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0538: Heat and N	lass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	4
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence Knowledge				
	 The students are capable of explaining qualitative chemical reactors). They are capable of distinguish and characterize di radiation. The students have the ability to explain the physical using suitable mass transfer theories. They are able to depict the analogy between heat-a 	ifferent kinds of heat transfer mechanisms nam	ely heat conduction, to	neat transfer and therma
Skills	 The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the course thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems. 			
Personal Competence Social Competence	 The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors a other students. 		ble manner to tutors an	
Autonomy	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-lik assignments) and on this basis they can control their learning processes. 			
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42			
Credit points				
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialis	eation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialis	ation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialis	sation Energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste	er): Specialisation Energy and Enviromental En	gineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory	Companie		
	Energy and Environmental Engineering: Core qualification:			
	0 15 1 0 75 11 10 10			
	General Engineering Science (English program): Specialist		ampulcos:	
	General Engineering Science (English program): Specialisa	ation Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist	ation Energy and Enviromental Engineering: Co ation Process Engineering: Compulsory		
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist General Engineering Science (English program, 7 semeste	ation Energy and Enviromental Engineering: Co ation Process Engineering: Compulsory r): Specialisation Process Engineering: Compu	lsory	
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist	ation Energy and Enviromental Engineering: Co ation Process Engineering: Compulsory r): Specialisation Process Engineering: Compu r): Specialisation Bioprocess Engineering: Con	lsory	1
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste	ation Energy and Enviromental Engineering: Co ation Process Engineering: Compulsory r): Specialisation Process Engineering: Compu r): Specialisation Bioprocess Engineering: Con r): Specialisation Energy and Enviromental Eng	lsory	,
	General Engineering Science (English program): Specialist General Engineering Science (English program): Specialist General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste	ation Energy and Enviromental Engineering: Co ation Process Engineering: Compulsory rr): Specialisation Process Engineering: Compu rr): Specialisation Bioprocess Engineering: Con rr): Specialisation Energy and Enviromental Eng e: Elective Compulsory	lsory	1



Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas	

Course L0102: Heat and Mass Transfer		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	Heat transfer	
	Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions The students work on tasks in small groups and present their results in front of all students.	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas	



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge				
	The students can distinguish and describe different types of a students.			
	The students develop an understanding for the course of course.		ss, the estimation of	the energy demand of
	process, the possibilities of energy saving, and the selection			
	They have good knowledge of designing methods for separate.	ation processes and devices		
Skills	Using the gained knowledge the students can select a reasc	onable system boundary for a given sep	aration process and	can close the associa
	energy and material balances	masie eyetem seamaary ter a given eep	aration process and	04.1 0.000 11.0 4000014
	The students can use different graphical methods for the des	igning of a congration process and defi	ne the amount of the	aretical etages require
	They can select and design a basic type of thermal separations.	ation process for a given case based to	on the advantages a	nu disauvantages of
	process	described a language from a constant		d to lete al
	The students are capable to obtain independently the neede The students are capable to obtain independently the neede		sources (diagrams an	d tables)
	They can calculate continuous and discontinuous processes			
	The students are able to prove their theoretical knowledge in the experimental lab work.			
	The students are able to discuss the theoretical background	and the content of the experimental wor	rk with the teachers ir	colloquium.
	The students are capable of linking their gained knowledge with the content of other lectures and use it teacher for the calution of teacher are the			n of technical proble
	The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, fluid mechanics and chemical engineering.			
	Care restares such as alemiodynamics, nata meetiames and onemi	oar engineering.		
Personal Competence				
Social Competence	The students can work technical assignments in small group	s and present the combined results in the	ne tutorial	
	- The stadents can work technical assignments in small group	o and present the demonica results in the	io tatoriai	
	The students are able to carry out practical lab work in sma	Il groups and organizo a functional divi	sion of labor batwas	n thom. Thou are able
			Sion of labor betwee	ii tilelli. Tiley ale abie
	discuss their results and to document them scientifically in a	report.		
Autonomy				
,	The students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the needed information from the students are capable to obtain the students are capable to obta	rom suitable sources by themselves and	d assess their quality	
	The students can proof the state of their knowledge with example.	m resembling assignments and in this w	ay control their learn	ing process
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
Credit points				
Examination				
Examination duration and scale	'			
Assignment for the Following	General Engineering Science (German program): Specialisation Pro			
Curricula	General Engineering Science (German program): Specialisation Bio	process Engineering: Compulsory		
	General Engineering Science (German program): Specialisation En	ergy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (German program, 7 semester): Spec	ialisation Energy and Enviromental Eng	ineering: Compulsor	y
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compul	sory		
	General Engineering Science (English program): Specialisation Bio			
			mpulsorv	
	General Engineering Science (English program): Specialisation Eng	. , = =ga. =goiig. 00		
	General Engineering Science (English program): Specialisation Engineering Science (English program): Specialisation Program	cess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Pro		cory	
	General Engineering Science (English program): Specialisation Pro General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compul	-	
	General Engineering Science (English program): Specialisation Pro General Engineering Science (English program, 7 semester): Speci General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compulation Bioprocess Engineering: Com	pulsory	
	General Engineering Science (English program): Specialisation Pro General Engineering Science (English program, 7 semester): Speci	alisation Process Engineering: Compulation Bioprocess Engineering: Com	pulsory	,



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry's Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie



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



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



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



Module M0639: Gas and St	eam Power Plants			
Courses				
Title		Тур	Hrs/wk	CP
Gas and Steam Power Plants (L0206)		Lecture	3	4
Gas and Steam Power Plants (L0210)		Recitation Section (large)	2	2
Module Responsible	Prof. Alfons Kather			
Admission Requirements	None			
Pagammandad Draviaus				
Recommended Previous Knowledge	"Technical Thermodynamics I and II"			
Knowledge	"Heat Transfer"			
	"Fluid Mechanics"			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	Alter taking part successiumy, students have reache	ed the following featiling results		
Knowledge	The students can evaluate the development of the	electricity demand and the energy conversion routes	in the thermal newer n	lant describe the vari
Knowieage		electricity demand and the energy conversion routes generator block and determine the operation charact		
		d other environmental protection measures, along w		
		, wind) power plants or plants equipped with Carbon (ssibilities of convention
	The students can on a basic level explain principle	les, operation and design of turbomachinery. They are	a able to describe the	environmental impact
		d the resulting climatic effects. They are able to nam		
	supply and network stability, also with economics of	and renewable energy sources and can name the operations	oumai technical options	s for providing securit
	supply and network stability, also with economics of	onsidered.		
Skills	The students are able, using theories and metho	ods of the energy technology from fossil fuels and b	ased on deep knowle	edge on the function
	construction of gas and steam power plants, to i	identify basic associations in the production of hear	and electricity, so as	to develop conception
	solutions. Through analysis of the problem and e	exposure to the inherent interconnections between h	eat and power genera	tion, the students wil
	endowed with the capability and methodology to	develop realistic optimal concepts for the environment	entally benign genera	tion of electricity and
	production of heat. From the technical basics the s	students become the ability to follow better the delibe	erations on the electrici	ty mix composition w
	the energy-political triangle (economy, secure supp	ply and environmental protection).		
	The students are able to highlight aspects of the design and development of power plant cycles with the specialised software su			
	Professional TM and to independently program simp		The second second	
	The students are able to do simplified calculations of turbo machinery as either an overall plant or as individual stages.			
Personal Competence				
Personal Competence Social Competence	The students are able to solve subject-specific eye	rcises in smalls groups and can present their commo	n results orally	
oodar oompetenee	The state his are able to solve stable of specific excl	roises in smalls groups and oan present their comme	rrosults ordiny.	
	· ·	al alternatives to reduce the environmental and soci	al footprint of their eng	ineering activities and
	support the energy revolution effectively.			
Autonomy	The students assisted by the tutors will be able to develop alone simple simulation models and run with these scenario analyses. In this manner			
	theoretical and practical knowledge from the led	cture is consolidated and the potential effects from	different process com	binations and bound
		analyse independently the operational performance		
	quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	Written examination of 120 min			
Assignment for the Following	General Engineering Science (German program): 9	Specialisation Energy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): 9	Specialisation Mechanical Engineering, Focus Energy	Systems: Compulsory	
	General Engineering Science (German program, 7	'semester): Specialisation Energy and Enviromental E	Engineering: Compulso	ry
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engineering, F	ocus Energy Systems:	Elective Compulsory
	Energy and Environmental Engineering: Core qual			•
	General Engineering Science (English program): S	Specialisation Energy and Enviromental Engineering:	Compulsory	
	Constant Francisco Colones (Francisch ausensen), C		Customa: Compulsory	
	General Engineering Science (English program): S	Specialisation Mechanical Engineering, Focus Energy	Systems. Compulsory	
		specialisation Mechanical Engineering, Focus Energy semester): Specialisation Energy and Enviromental E		у
	General Engineering Science (English program, 7		ngineering: Compulsor	



Course Loogs Coo and Steam Bour	as Dlauke
Course L0206: Gas and Steam Pow	
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
	parto de octato an oron on on mana ponor planto lo onotos, motosting.
	Electricity demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in thermal power plants
	Types of power plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials for power plants
	Location of power plants
	Solar shermal plants/geothermal plants/Carbon Capture and Storage plants
	These are complemented in the 2 nd part of the module by the more specialised issues:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	The spiral and the spiral for the first of the latest of t
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus of the lecture and the
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discussed and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.
	A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with the whole subject field of gas and steam power plants. Through discussions with plant personnel the students are able to obtain an overview on daily
	operation problems and their solution approach.
	This activity hinges, however, upon the availability of support financing and as such it cannot always be guaranteed.
Literature	Kalide: Kraft- und Arbeitsmaschinen
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
	T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer
	Verlag Resch / Verlag TÜV Rheinland



L0210: Gas and Steam Powe	A F MINO
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	
Content	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	• waste neat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus of the lecture and
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discus-
	and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In
	critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness fo
	responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With this tool small tasks
	solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterw
	ask questions and get feedback. The course work has a positive effect on the students final grade.
Literature	
Literature	Skripte
	Kalide: Kraft- und Arbeitsmaschinen
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
	 Kugeler und Philippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis



Module M0933: Fundamen	als of Materials Science			
Courses				
itle		Тур	Hrs/wk	CP
undamentals of Materials Science I (L10	•	Lecture	2	2
	ranced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2
nysical and Chemical Basics of Materials	Prof. Jörg Weißmüller	Lecture	2	2
	*			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ig learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on a	metals, ceramics and polymers a	and can describe this know	rledge comprehensiv
	Fundamental knowledge here means specifically the issues of	atomic structure, microstructure, ph	ase diagrams, phase transf	ormations, corrosion a
	mechanical properties. The students know about the key aspe	cts of characterization methods for	r materials and can identify	relevant approaches
	characterizing specific properties. They are able to trace materia	Is phenomena back to the underlying	ng physical and chemical lav	vs of nature.
OL III.	The state of the s	and the second s	Harris of making Makedalan	h
Skills	The students are able to trace materials phenomena back to the			
	mechanical properties such as strength, ductility, and stiffness,			
	solidification, precipitation, or melting. The students can explain		conditions and the materials	microstructure, and t
	can account for the impact of microstructure on the material's bel	navior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Environmental Enginee	ring: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compuls	sory	
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compuls	ory	
	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Biomedical Engineerin	ng: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architecture: Co	ompulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Energy and Enviromer	ntal Engineering: Compulso	ry
	Energy and Environmental Engineering: Core qualification: Com	pulsory		
	General Engineering Science (English program): Specialisation	Energy and Environmental Engineer	ring: Compulsory	
	General Engineering Science (English program): Specialisation	Mechanical Engineering: Compulse	ory	
	General Engineering Science (English program): Specialisation	Biomedical Engineering: Compulso	ory	
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineerin	ng: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedical Engineerin	g: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Co	mpulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Energy and Enviromen	ntal Engineering: Compulsor	у
	Logistics and Mobility: Specialisation Engineering Science: Elec	tive Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			

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



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

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



Module M0956: Measureme	ent Technology for Mechanical and Proces	ss Engineers		
Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Contr	rol Systems (L1119)	Laboratory Course	2	2
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1
Module Responsible	Dr. Sven Krause			
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical eng	ineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundment	als of the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static and
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods	for different kinds of quantities to be massured (Flectrical Quantities	Temperature mechanica
	quantities, Flow, Time, Frequency).	To different kinds of qualitates to be indesured (Licotioai Quarititico,	remperature, meditamea
	quantities, Flow, Filic, Frequency).			
	They can describe important methods of chemical Analys	sis (Gas Sensors, Spectroscopy, Gas Chromatogr	aphy)	
Skills	Students can select suitable measuring methods to giver	problems and can use refering measurement de	evices in practice.	
	The students are able to evall, analysis issues in the cube			
	The students are able to orally explain issues in the sub	ject area of measurement technology and solution	on approaches as wei	i as piace the issues into
	the right context and application area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and docume	ent them in a common report.		
Autonomy	Students are able to familiarize themselves with new mea	asurement technologies.		
Wester de Herre	Industrial Old Trackle Old Trackle Industrial			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specia		Compulsory	
Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia		ainooring, O	
	General Engineering Science (German program, 7 seme	, , , , , , , , , , , , , , , , , , ,		у
	General Engineering Science (German program, 7 seme	, ,		
	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme			
	Energy and Environmental Engineering: Core qualification		uisoly	
	General Engineering Science (English program): Specia	' '	omnulsory	
	General Engineering Science (English program): Specia	**	отпривоту	
	General Engineering Science (English program): Specia	0 0 1 ,		
	General Engineering Science (English program): Specia			
	General Engineering Science (English program, 7 semes		gineering: Compulsor	V
	General Engineering Science (English program, 7 semes	, ,		,
	General Engineering Science (English program, 7 semes	, ,		
	General Engineering Science (English program, 7 semes			
Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory			



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



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

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



Module M1275: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technol	ogy (L1387)	Laboratory Course	1	1
Environmental Technologie (L0326)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound k	nowledge of environmental technological	ogy. They are able to de	escribe the behaviour of
	chemicals in the environment. Students can give an overview of	scientific disciplines involved. They	can explain terms and	allocate them to related
	methods.			
Skille	Students are able to propose appropriate management and mitiga	tion massures for anyironmental are	blome Thoy are able to	dotormino googhomical
Skills	parameters and to assess the potential of pollutants to migrate			
	Environmental Technology contributes to sustainable development			·
	Environmental resimology contributes to sustainable development	, and may our present and delend in	osc opinions in noncora	na agamst the group.
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different			
	approaches to the task as a group as well as to discuss their theore	tical or practical implementation.		
Autonomy	Students can independently exploit sources about of the subject, ac	equire the particular knowledge and t	ranfer it to new problems	S.
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Specialisation Er	nergy and Enviromental Engineering	: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Pr	ocess Engineering: Elective Compul	sory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Energy and Enviromental	Engineering: Compulsor	у
	General Engineering Science (German program, 7 semester): Spec	cialisation Process Engineering: Elec	tive Compulsory	
	General Engineering Science (German program, 7 semester): Spec	cialisation Bioprocess Engineering: E	lective Compulsory	
	Bioprocess Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En	**		
	General Engineering Science (English program): Specialisation Program			
	General Engineering Science (English program, 7 semester): Spec	••		′
	General Engineering Science (English program, 7 semester): Spec			
	General Engineering Science (English program, 7 semester): Spec	ialisation Bioprocess Engineering: E	lective Compulsory	
	Process Engineering: Core qualification: Elective Compulsory			

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



Course L0326: Environmental Technologie		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)	



	chnology and Solids Process Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L0434)		Lecture	2	3
Particle Technology I (L0435)		Recitation Section (small)	1	1
Particle Technology I (L0440)		Laboratory Course	2	2
Module Responsible	Prof. Stefan Heinrich			
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able	e to		
	 name and explain processes and unit-operations of 	f collide process anginogring		
	characterize particles, particle distributions and to compare the compared to the characterize particles.			
	onarasiones parasios, parasio alcanoano ana to o	acade their samproperties		
Skills	Students are able to			
Skills	Students are able to			
	 choose and design apparatuses and processes for 	solids processing according to the desired solids	properties of the pr	oduct
	 asses solids with respect to their behavior in solids 	processing steps		
	 document their work scientifically. 			
Paragral Commissions				
Personal Competence	The students our chief to discuss an invite tening quality with			de la
Social Competence	The students are able to discuss scientific topics orally with a group.	officer students of scientific personal and to devi	elop solutions for tec	annical-scientific issues
Autonomy	a group.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
	6			
Credit points	*			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Speciali			
Curricula	General Engineering Science (German program): Speciali			
	General Engineering Science (German program): Specialis			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 semest	er): Specialisation Energy and Enviromental Eng	ineering: Compulso	ry
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification			
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis		mpulsory	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste	er): Specialisation Bioprocess Engineering: Comp	oulsory	
	General Engineering Science (English program, 7 semeste	er): Specialisation Energy and Enviromental Engi	neering: Compulsor	у
	Process Engineering: Core qualification: Compulsory			



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

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

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



Module M1274: Environme	ntal Technology			
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt	· ,		
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge	The state of the s			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence	The aliming part decesses any, eladerne nave reaction and to	5.10 m.ng .00 m.ng .00 m.ng		
Knowledge	With the completion of this module the students acquire in	a-denth knowledge of important cause-effect ch	ains of notential enviro	nmental problems whi
Knowledge	might occur from production processes, projects or constru			
	in dealing with different methods and instruments to asset environmental processes as well as uncertainties and diffi		its are able to estimate	the complexity of the
Chille	·		-4	
Skills				
	solutions for managing and mitigating environmental pr			
	independently and can apply the software programs Open to critically judge research results or other publications on		g the course the stude	nts have the competen
	to critically judge research results of other publications of	environmental impacis.		
Personal Competence				
Social Competence	The students are able to discuss the various technical ar	nd scientific tasks, both subject-specific and mu	ultidisciplinary. They ar	re able to develop join
	different solutions and to discuss their theoretical or prac-	tical implementation. Due to the selected lectu	re topics, the students	receive insights into
	multi-layered issues of the environment protection and the	he concept of sustainability. Their sensitivity a	and consciousness tow	vards these subjects a
	raised and which helps to raise their awareness of their fut	ture social responsibilities in their role as engin	eers.	
Autonomy	The students learn to research, process and present a so	cientific topic independently. They are able to	carry out independent	scientific work. They ca
	solve an environmental problem in a business context and	d are able to judge results of other publications.		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the Following	General Engineering Science (German program): Speciali	isation Energy and Environmental Engineering: (Compulsory	
Curricula	General Engineering Science (German program): Speciali			
241104114	General Engineering Science (German program, 7 semes			v
	General Engineering Science (German program, 7 semes			,
	General Engineering Science (German program, 7 semes			
	Bioprocess Engineering: Core qualification: Elective Comp			
1	Energy and Environmental Engineering: Core qualification	•		
	General Engineering Science (English program): Specialis		Compulsory	
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program, 7 semest		•	/
li di		,oatong, andtomonial	.gpaisor	
	General Engineering Science (English program 7 semest	er): Specialisation Process Engineering: Flective	e Compulsory	
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest Process Engineering: Core qualification: Elective Compuls	er): Specialisation Bioprocess Engineering: Ele		



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

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



Specialization Biomedical Engineering

Module M0933: Fundament	tals of Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Materials Science I (L10	•	Lecture	2	2
,	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on me			
	Fundamental knowledge here means specifically the issues of atc			
	mechanical properties. The students know about the key aspects			
	characterizing specific properties. They are able to trace materials p	phenomena back to the underlying	g physical and chemical laws	s of nature.
Skills	The students are able to trace materials phenomena back to the u	nderlying physical and chemical	laws of nature. Materials phe	enomena here refers to
	mechanical properties such as strength, ductility, and stiffness, che		·	
	solidification, precipitation, or melting. The students can explain th	e relation between processing co	onditions and the materials n	nicrostructure, and they
	can account for the impact of microstructure on the material's behav	vior.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation En	nergy and Enviromental Engineeri	ng: Compulsory	
Curricula	General Engineering Science (German program): Specialisation M	echanical Engineering: Compulso	ory	
	General Engineering Science (German program): Specialisation Bi	omedical Engineering: Compulso	ry	
	General Engineering Science (German program): Specialisation No	aval Architecture: Compulsory		
	Energy and Environmental Engineering: Core qualification: Compu	Isory		
	General Engineering Science (English program): Specialisation En	ergy and Enviromental Engineering	ng: Compulsory	
	General Engineering Science (English program): Specialisation Me	echanical Engineering: Compulso	ry	
	General Engineering Science (English program): Specialisation Bio		У	
	General Engineering Science (English program): Specialisation Na			
	Logistics and Mobility: Specialisation Engineering Science: Elective	Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory	0		
	Technomathematics: Specialisation Engineering Science: Elective	Compulsory		

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



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

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



Module M063/: Introductio	n into Medical Technology and Syst	tome		
nodule M0034. IIItroductio	ir into medicar recimology and Syst	tems		
ourses				
itle		Тур	Hrs/wk	СР
ntroduction into Medical Technology and	Systems (L0342)	Lecture	2	3
ntroduction into Medical Technology and	Systems (L0343)	Problem-based Learning	4	3
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	none			
Recommended Previous	principles of math (algebra, analysis/calculus)			
Knowledge	principles of stochastics			
	principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	The students can explain medical technology a	nd its principles, including imaging systems, computer a	ided surgery, medical	sensor systems, medi
	information systems. They are able to give an ov	verview of regulatory affairs and standards in medical tech	nnology.	
Chille	The shiplests are able to each region in less of sea different			
Skills	The students are able to apply principles of medi	ical technology to solving actual problems.		
Davasnal Commetence				
Personal Competence	The shidents describe a supplication and indicate the		ining officer	
Social Competence	The students describe a problem in medical tech	nnology as a project, and define tasks that are solved in a	Joint ellort.	
Autonomy	The students can reflect their knowledge and do	cument the results of their work. They can present the res	ults in an appropriate	manner.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program	i): Specialisation Biomedical Engineering: Compulsory		
Curricula	Computer Science: Specialisation Computer Eng			
	Electrical Engineering: Core qualification: Electiv			
	General Engineering Science (English program)): Specialisation Biomedical Engineering: Compulsory		
	Biomedical Engineering: Specialisation Artificial	Organs and Regenerative Medicine: Elective Compulsor	ту	
	Biomedical Engineering: Specialisation Implants	s and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical	Technology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manage	ement and Business Administration: Elective Compulsory		
	Technomathematics: Specialisation Engineering	Science: Elective Compulsory		

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

Course L0343: Introduction into Medical Technology and Systems	
Тур	Problem-based Learning
Hrs/wk	4
CP	3
Workload in Hours	Independent Study Time 34, Study Time in Lecture 56
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0672: Signals and	l Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0432)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(3.,		
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,	-	•	
			<u> </u>	
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linea	(, ,	,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I		in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sign	·	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and free	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app		itrol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation Computer Science: Core qualification: Compulsory	Biomedical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Civil- and Environmental Engangering: Co	mnuleory	
	General Engineering Science (English program): Specialisation		лпривогу	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsorv	
	General Engineering Science (English program): Specialisation		/	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electiv	ve Compulsory		



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

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



Module M0648: MED I: Medi	ical Basics I				
Courses		T	Unabode	O.D.	
Title Introduction to Anatomy (L0384)		Typ Lecture	Hrs/wk 2	CP 3	
Introduction to Radiology and Radiation Th	nerapy (L0383)	Lecture	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements Recommended Previous	None None.				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results			
Professional Competence Knowledge	Therapy				
rune meage			ali ati a a tha a a a a		
	The students can distinguish different types of currently used ed				
	The students can explain complex treatment plans used in radi	ation therapy in interdisciplinary con	texts (e.g. surgery, internal m	edicine).	
	The students can describe the patients' passage from their initial	al admittance through to follow-up ca	are.		
	Diagnostics				
	The students can illustrate the technical base concepts of p imaging techniques (CT, MRT, US).	rojection radiography, including an	giography and mammograph	ny, as well as sectiona	
	The students can explain the diagnostic as well as therapeutic	use of imaging techniques, as well a	as the technical basis for those	techniques.	
	The students can choose the right treatment method depending	g on the patient's clinical history and	needs.		
	The student can explain the influence of technical errors on the	imaging techniques.			
	The student can draw the right conclusions based on the image	es' diagnostic findings or the error pr	otocol.		
	Anatomy				
	The students can describe				
	basal structures and functions of internal organs and the muscu	uloskeletal system			
	Ü	•			
	The students can describe the basic macroscopy and microsco	py of those systems.			
Skills	Therapy				
	The students can distinguish curative and palliative situations a	and motivate why they came to that c	onclusion.		
	The students can develop adequate therapy concepts and rela	te it to the radiation biological aspec	ts.		
	The students can use the therapeutic principle (effects vs adver	rse effects)			
	The students can distinguish different kinds of radiation, can energy needed in that situation (irradiation planning).	choose the best one depending on	the situation (location of the	tumor) and choose the	
		energy needed in that situation (irradiation planning). The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups,			
	Diagnostics				
	The students can suggest solutions for repairs of imaging instru	ımentation after having done error a	nalyses.		
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology and pathophysiology.				
	Anatomy				
	The students can recognize the relationship between given an of structures and their functions in the context of widespread dis		of common diseases; they ca	an explain the relevanc	
Personal Competence					
Social Competence	The students can assess the special social situation of tumor pa	atients and interact with them in a pro	ofessional way.		
	The students are aware of the special, often fear-dominated be appropriately.	havior of sick people caused by diag	gnostic and therapeutic meas	ures and can meet the	
	The students can participate in current discussions in biomedical research and medicine on a professional level.				
Autonomy		·			
Autonomy					
,	The students can introduce younger students to the clinical dail				
l	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and a relevant knowledge themselves.				
	relevant knowledge themselves.				
W	relevant knowledge themselves.				
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56				



Examination duration and scale	90 Minuten, many questions
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Technomathematics: Specialisation Engineering Science: Elective Compulsory

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



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



Module M0680: Fluid Dynar	nics			
Courses				
Title		Tun	Hrs/wk	CP
Fluid Mechanics (L0454)		Typ Lecture	3	5
Fluid Mechanics (L0454)		Recitation Section (large)	1	1
Module Responsible	Prof. Heinz Herwig	riodiation decitor (large)		
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II			
Knowledge	•			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	The students are able to			
	- distinguish the different physical mechanism of fluid dynamics,			
	- understand the different mathematic modeling of fluid flow,			
	- to apply and calculate fluid flow processes in different problems in r	nature and techniques.		
Skills	The students are able to			
	- understand the physics of Fluid Dynamics,			
	- calculate and evaluate complex Fluid Dynamics processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an app	proach.		
Autonomy	The students are able to develop a complex problem self-consistent	and analyse the results in a critical wa	ay. A qualified exchan	ge with other students is
	given.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Me	chanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bio	medical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Med	chanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Bior	medical Engineering: Compulsory		
	Computational Science and Engineering: Specialisation Engineering	g Sciences: Elective Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Elective C	compulsory		
	recimomatilematics. Specialisation Engineering Science: Elective C	ompulaory		

Course L0454: Fluid Mechanics	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Heinz Herwig
Language	DE
Cycle	SoSe
Content	Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows
Literature	 Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004



Course L0455: Fluid Mechanics		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heinz Herwig	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0960: Mechanics	IV (Kinetics II, Oscillations, Analytical Mech	nanics, Multibody Systems)		
Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1137)		Lecture	3	3
Mechanics IV (Kinetics II, Oscillations, Ana	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillations, Ana	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mechanics I (Statics) and Mechanics III (Hydrostatics, Kine	matics, Dynamics)		
Knowledge	Mathematics I and II			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	The students can			
Skills	 describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. 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 groups and support each other to	o overcome difficulties.		
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Speciali	sation Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speciali	sation Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Speciali	sation Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialis	sation Mechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialis	sation Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialis	sation Naval Architecture: Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compuls			
	Theoretical Mechanical Engineering: Technical Complement	entary Course Core Studies: Elective Compulsor	ry	

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



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

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



Module M0598: Mechanical	Engineering: Design			
Courses				
Title		Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD (L0268)		Lecture	2	1
Mechanical Design Project I (L0695)		Practical Course	3	2
Mechanical Design Project II (L0592)		Practical Course	3	2
Team Project Design Methodology (L0267)	Problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	 explain design guidelines for machinery parts e.g. consic 	dering load situation, materials and manuf.	acturing requirements	
	 describe basics of 3D CAD, 	3 ,	3 - 4	,
	 explain basics methods of engineering designing. 			
Skille	After passing the module, students are able to:			
Okliis				
	 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 tas	ks systamtically and solution-oriented,		
	 apply creativity techniques in teams. 			
Personal Competence				
Social Competence	After passing the module, students are able to:			
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, 			
	 present and discuss solutions and technical drawings with 	thin groups		
	 reflect the own results in the work groups of the course. 	ami groups,		
Autonomy	Students are able			
	to estimate their level of knowledge using activating met	thods within the lectures (e.g. with clickers),	
To solve engineering design tasks systematically.				
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Enviromental Engineering: C	Compulsory	
Curricula	General Engineering Science (German program): Specialisation	Mechanical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Medianical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory			
	Energy and Environmental Engineering: Core qualification: Com	npulsory		
	General Engineering Science (English program): Specialisation	Energy and Environmental Engineering: C	ompulsory	
	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): Sp	pecialisation Mechanical Engineering: Cor	mpulsory	
	General Engineering Science (English program, 7 semester): Sp	pecialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester): Sp	pecialisation Energy and Enviromental En	gineering: Compulsor	<i>y</i>
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



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

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



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

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



Module M0646: BIO I: Impla	nts and Testing			
Courses				
Title		Тур	Hrs/wk	СР
Experimental Methods in Biomechanics (L	0377)	Lecture	2	3
nplants and Fracture Healing (L0376)		Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implantate und Fraktı	urheilung" before attending "Experimentelle	e Methoden".	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students can describe the different ways how bones	heal, and the requirements for their exister	ice.	
	The students can name different treatments for the spine	and hollow bones under given fracture mo	rphologies.	
	The students can describe different measurement technic	ques for forces and movements, and choos	e the adequate technique for	a given task.
Skills	The students can determine the forces acting within the h	uman body under quasi-static situations u	nder specific assumptions.	
	The students can describe the basic handling of several	experimental techniques used in biomecha	anics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic experimental tas	sks.		
Autonomy	The students can, in groups, solve basic experimental tas	sks.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, many questions			
Assignment for the Following	General Engineering Science (German program): Specia	lisation Mechanical Engineering, Focus Bi	omechanics: Compulsory	
Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program, 7 seme		•	mpulsory
	General Engineering Science (German program, 7 seme			, ,
	General Engineering Science (English program): Specia			
	General Engineering Science (English program): Specia		•	
	General Engineering Science (English program, 7 semes			npulsory
	General Engineering Science (English program, 7 semes			. ,
	Mechanical Engineering: Specialisation Biomechanics: 0		- ' '	
	Biomedical Engineering: Specialisation Artificial Organs		pulsory	
	Biomedical Engineering: Specialisation Implants and Engineering		,	
	Biomedical Engineering: Specialisation Medical Technol		ory	
	Biomedical Engineering: Specialisation Management an			
	Technomathematics: Specialisation III. Engineering Scient		•	

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



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



Module M0662: Numerical I	Mathematics I			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematik I + II for Engineering Students (german or engl basic MATLAB knowledge	ish) or Analysis & Linear Algebra I + II fo	r Technomathematicia	ans
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to name numerical methods for interpolation, integration, le explain their core ideas,	ast squares problems, eigenvalue prob	lems, nonlinear root	finding problems and t
	repeat convergence statements for the numerical methods explain aspects for the practical execution of numerical methods.		storage complexitx.	
Skills	Students are able to			
	implement, apply and compare numerical methods using N justify the convergence behaviour of numerical methods w select and execute a suitable solution approach for a giver	ith respect to the problem and solution al	gorithm,	
Personal Competence Social Competence	Students are able to			
	 work together in heterogeneously composed teams (i.e., foundations and support each other with practical aspects 			dge), explain theoretica
Autonomy	Students are capable			
	to assess whether the supporting theoretical and practical to assess their individual progess and, if necessary, to ask		or in a team,	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation (Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisation M	Mechanical Engineering, Focus Biomech	anics: Compulsory	
	General Engineering Science (German program): Specialisation M	Mechanical Engineering, Focus Materials	in Engineering Scier	nces: Compulsory
	General Engineering Science (German program): Specialisation E	Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Spe	ecialisation Computer Science: Compulse	ory	
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineering	g, Focus Materials in	Engineering Science
	Compulsory			
	General Engineering Science (German program, 7 semester): Spe	ecialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engineering, Foo	cus Biomechanics: Co	mpulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering:	ngineering: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: El	ective Compulsory		
	Electrical Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation C			
	General Engineering Science (English program): Specialisation B			
	General Engineering Science (English program): Specialisation N	• •		
	General Engineering Science (English program): Specialisation N	• •		ces: Compulsory
	General Engineering Science (English program, 7 semester): Spe	·	•	Engineering Original
	General Engineering Science (English program, 7 semester): Compulsory			i ⊑ngmeering Science
	General Engineering Science (English program, 7 semester): Spe	• •		
	General Engineering Science (English program, 7 semester): Spe		us Biomechanics: Co	mpulsory
	Computational Science and Engineering: Core qualification: Com	•		
	Process Engineering: Specialisation Process Engineering: Elective	e Compulsory		



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

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



Module M0684: Heat Trans	ier			
modulo modo m mode mano				
Courses				
Title		Тур	Hrs/wk	CP
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)		Recitation Section (large)	2	1
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	asserbe are amorem priyered meetia men er real rander,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
D				
Personal Competence	The shiplestance ship to discuss in small account and develop an account	ava a ab		
Social Competence	The students are able to discuss in small groups and develop an app	oroacn.		
Autonomy	The students are able to develop a complex problem self-consistent	and analyse the results in a critical wa	ay. A qualified exchan	ge with other students is
	given.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
	6			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min	the size I Feeting day Francis		
Assignment for the Following	General Engineering Science (German program): Specialisation Me			
Curricula	General Engineering Science (German program): Specialisation Me General Engineering Science (German program): Specialisation Bio		systems: Compulsory	
	General Engineering Science (German program): Specialisation Me		ral Mechanical Engine	ering: Compulsory
	General Engineering Science (German program, 7 semester): Speci	•	-	
	General Engineering Science (German program, 7 semester): Sp			
	Compulsory			
	General Engineering Science (German program, 7 semester): Speci	alisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (English program): Specialisation Bior		•	
	General Engineering Science (English program): Specialisation Med		anics: Compulsory	
	General Engineering Science (English program): Specialisation Med	chanical Engineering, Focus Energy S	ystems: Compulsory	
	General Engineering Science (English program): Specialisation Med	chanical Engineering, Focus Theoretic	al Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Engineering, Foc	us Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical Engineering,	Focus Theoretical M	lechanical Engineering
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia	alisation Biomedical Engineering: Com	pulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulso			
	Mechanical Engineering: Specialisation Theoretical Mechanical Eng	ineering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014
	- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



Course L0459: Heat Transfer	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0956: Measureme	ent Technology for Mechanical and Process E	Engineers		
Courses				
Title		Тур	Hrs/wk	СР
Practical Course: Measurement and Conti	rol Systems (L1119)	Laboratory Course	2	2
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1
Module Responsible	Dr. Sven Krause			
Admission Requirements	none			
Recommended Previous	Basic knowledge of physics, chemistry and electrical enginee	ring		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	Students are able to name the most important fundmentals of	of the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static ar
	Dynamic Properties of Sensors and Systems).			
	They can outline the most important measuring methods for o	different kinds of quantities to be maesured (Electrical Quantities.	Temperature, mechanic
	quantities, Flow, Time, Frequency).			
	They can describe important methods of chemical Analysis (G	Gas Sensors, Spectroscopy, Gas Chromatogr	aphy)	
Skills	Students can select suitable measuring methods to given pro-	blems and can use refering measurement de	vices in practice.	
	The students are able to orally explain issues in the subject a	area of measurement technology and solution	on annroaches as wel	I as place the issues in
	the right context and application area.	area of measurement technology and solution	лі арріоаспез аз жеі	i as piace the issues in
	are ngm comon and approximation area.			
Personal Competence				
Social Competence	Students can arrive at work results in groups and document the	nem in a common report.		
Autonomy	Students are able to familiarize themselves with new measure	ement technologies.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	105 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Energy and Environmental Engineering: (Compulsory	
Curricula	General Engineering Science (German program): Specialisate General Engineering Science (German program): Specialisate		ompulsory	
Garriodia	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program): Specialisat			
	General Engineering Science (German program, 7 semester)		gineering: Compulsor	γ
	General Engineering Science (German program, 7 semester)			-
	General Engineering Science (German program, 7 semester)			
	General Engineering Science (German program, 7 semester)			
	Energy and Environmental Engineering: Core qualification: C		-	
	General Engineering Science (English program): Specialisati	on Energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (English program): Specialisati	on Mechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	on Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	on Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Environmental En	gineering: Compulsor	y
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineering: Co	mpulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engineering: Cor	npulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Compu	ılsory	
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory			



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



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

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



Module M1279: MED II: Intra	oduction to Biochemistry and Molecula	ar Riology		
Wodule W1279. WED II: IN(r)	duction to blochemistry and molecula	ar blology		
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and Molecular	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
	The students can			
	 describe basic biomolecules; 			
	 explain how genetic information is coded in the 	he DNA:		
	explain the connection between DNA and pro			
	·			
Skills				
	The students can			
	recognize the importance of molecular param	neters for the course of a disease;		
	describe different molecular-diagnostic treatr	nents;		
	describe the importance of the control of the contr	- di		
	describe the importance of those treatments for some	e diseases;		
Personal Competence				
Social Competence				
	The students can conduct discussions in research at	nd medicine on a technical level.		
Autonomy	The students can develop understanding of topics fro	om the course jusing technical literature, by thems	elves	
Autonomy	The stadents can develop understanding of topics in	on the course, using technical interature, by thems	eives	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 2	8		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Mechanical Engineering, Focus Biom	nechanics: Compulsory	·
Curricula	General Engineering Science (German program): Sp	pecialisation Biomedical Engineering: Compulsory	/	
	General Engineering Science (German program, 7 s	emester): Specialisation Biomedical Engineering:	Compulsory	
	General Engineering Science (German program, 7 s		, Focus Biomechanics: Com	pulsory
	Electrical Engineering: Specialisation Medical Techn			
	General Engineering Science (English program): Sp			
	General Engineering Science (English program): Sp			
	General Engineering Science (English program, 7 sc			buisory
	General Engineering Science (English program, 7 sc	, ,	Compulsory	
	Mechanical Engineering: Specialisation Biomechani Biomedical Engineering: Specialisation Managemer	• •	arv.	
	Biomedical Engineering: Specialisation Management Biomedical Engineering: Specialisation Artificial Org			
	Biomedical Engineering: Specialisation Artificial Org	·	•	
	Biomedical Engineering: Specialisation Implants and			
	Technomathematics: Core qualification: Elective Cor			
	Technomathematics: Specialisation III. Engineering			
	To the state of th			

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



courses				
itle		Тур	Hrs/wk	СР
troduction to Management (L0880) roject Entrepreneurship (L0882)		Lecture Problem-based Learning	4 2	4
Module Responsible	Prof. Christoph Ihl	1 Toblem-based Learning	2	2
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	After taking this module, students know the important basics of many diffe Marketing and Innovation, and also to Investment and Controlling. In particu		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Management and t	the sub-disciplines in Managen	nent and to name impo	ortant definitions from t
	field of Management			
	explain the most important aspects of and goals in Management and			
	describe and explain basic business functions as production, procured management information management inposestion management.		chain management,	organization and hum
	ressource management, information management, innovation mana explain the relevance of planning and decision making in Busine		ultiple objectives and	uncertainty and evol
	some basic methods from mathematical Finance	33, esp. in situations under mi	disple objectives and	uncertainty, and expire
	state basics from accounting and costing and selected controlling m	ethods.		
Skills	Students are able to analyse business units with respect to differer Entrepreneurship project in a team. In particular, they are able to	nt criteria (organization, obje	ctives, strategies etc) and to carry out
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under	r uncertainty and under rick		
	 apply methods for decision making under multiple objectives, under analyse production and procurement systems and Business information 			
	analyse and apply basic methods of marketing	alon dyclomo		
	select and apply basic methods from mathematical finance to prede	fined problems		
	apply basic methods from accounting, costing and controlling to pre	defined 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 pro to communicate appropriately and 	oject and write a conerent repor	t on the project	
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical	Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Computer			
	General Engineering Science (German program): Specialisation Process E	ingineering: Compulsory		
	General Engineering Science (German program): Specialisation Bioproces	s Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy an	-		
	General Engineering Science (German program): Specialisation Civil- and		mpulsory	
	General Engineering Science (German program): Specialisation Mechanica			
	General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Naval Arci			
	General Engineering Science (German program, 7 semester): Specialisation		oulsorv	
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation		•	
	General Engineering Science (German program, 7 semester): Specialisation	on Naval Architecture: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialisation	on Computer Science: Compuls	ory	
	General Engineering Science (German program, 7 semester): Specialisation	, , ,		
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisatio			
	General Engineering Science (German program, 7 semester): Specialisation			
	General Engineering Science (German program, 7 semester): Specialisation	-		
	General Engineering Science (German program, 7 semester): Specialisatio General Engineering Science (German program, 7 semester): Specialis	-	•	
	Compulsory	sauon weenanica Engineerin	g, i ocus iviateriais In	Lingingering Science
	General Engineering Science (German program, 7 semester): Specialis	ation Mechanical Engineering	, Focus Theoretical M	Mechanical Engineeri



Compulsory

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

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfga
Lecturer	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.

Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M1280: MED II: Intro	oduction to Physiology	
Courses		
	Tun. Healide OD	
Title Introduction to Physiology (L0385)	Typ Hrs/wk CP Lecture 2 3	
Module Responsible		
Admission Requirements		
Recommended Previous	None	
Knowledge Educational Objectives	After taking part successfully, students have reached the following learning results	
	Aller taking part successionly, students have reached the following rearning results	
Professional Competence		
Knowledge	The students can	
	The Students dan	
	describe the basics of the energy metabolism;	
	 describe the basics of the energy metabolish, describe physiological connections in select fields of muscle, heart/circulation, neuro- and sensory physiology. 	
	Cooling physiological commodicine in colocinical of medical includes in medical and control physiology.	
Skills		
	The students can	
	describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vital functions)	tions) and
	relate them to similar technical systems.	-, -, -
Personal Competence		
Social Competence		
	The students can conduct discussions in research and medicine on a technical level.	
	The students can find solutions to problems in the field of physiology, both analytical and metrological	
Autonomy	The students can develop understanding of topics from the course, using technical literature, by themselves	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Examination	Written exam	
Examination duration and scale	60 minutes	
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory	
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory	
	Technomathematics: Core qualification: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
	1	

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



Specialization Naval Architecture

Module M0933: Fundamen	tals of Materials Science			
0				
Courses		Turn	Hrs/wk	CP
Fundamentals of Materials Science I (L10	05)	Typ Lecture	Hrs/wk	2
,	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on me	tals, ceramics and polymers and	can describe this knowle	edge comprehensively.
	Fundamental knowledge here means specifically the issues of atc	mic structure, microstructure, phase	e diagrams, phase transfo	rmations, corrosion and
	mechanical properties. The students know about the key aspects	of characterization methods for m	aterials and can identify r	elevant approaches for
	characterizing specific properties. They are able to trace materials p	phenomena back to the underlying p	physical and chemical law	s of nature.
01.71	The state of the s	and and the configuration to a state of the configuration		
Skills	·		•	
	mechanical properties such as strength, ductility, and stiffness, che solidification, precipitation, or melting. The students can explain th			
	can account for the impact of microstructure on the material's behavior		ultions and the materials i	microstructure, and triey
	can account for the impact of flictostructure on the fliaterial's beneat	nor.		
Paragral Compatance				
Personal Competence Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Er	nergy and Enviromental Engineering	g: Compulsory	
Curricula	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program): Specialisation Bi			
	General Engineering Science (German program): Specialisation Na			
	Energy and Environmental Engineering: Core qualification: Compu			
	General Engineering Science (English program): Specialisation En	ergy and Enviromental Engineering	g: Compulsory	
	General Engineering Science (English program): Specialisation Me	chanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Bio	omedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Na	val Architecture: Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Elective	e Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Elective	Compulsory		

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



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

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



courses				
itle		Тур	Hrs/wk	СР
ntroduction to Management (L0880)		Lecture	4	4
roject Entrepreneurship (L0882)	Durf Objects Hill	Problem-based Learning	2	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 3		
Knowledge	After taking this module, students know the important basics of Marketing and Innovation, and also to Investment and Controlli		nagement, from Plani	ning and Organisation
	explain the differences between Economics and Manag- field of Management explain the most important aspects of and goals in Man			
	describe and explain basic business functions as proc ressource management, information management, inno explain the relevance of planning and decision making	ovation management and marketing		
	some basic methods from mathematical Finance state basics from accounting and costing and selected of	controlling methods.		
Skills	Students are able to analyse business units with respective Entrepreneurship project in a team. In particular, they are able		tives, strategies etc) and to carry out a
	analyse Management goals and structure them appropriately.	•		
	analyse organisational and staff structures of companie	s		
	apply methods for decision making under multiple objections.			
	 analyse production and procurement systems and Busi analyse and apply basic methods of marketing 	ness information systems		
	select and apply basic methods from mathematical final	nce to predefined problems		
	apply basic methods from accounting, costing and continuous apply basic methods.			
Personal Competence Social Competence				
	work successfully in a team of students			
	to apply their knowledge from the lecture to an entrepre	neurship project and write a coherent report	on the project	
	to communicate appropriately and			
	to cooperate respectfully with their fellow students.			
Autonomy	Students are able to			
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination				
	90 Minuten			
Examination duration and scale				
Examination duration and scale Assignment for the Following	General Engineering Science (German program): Specialisation	on Electrical Engineering: Compulsory		
			pulsory	
Assignment for the Following		on Computer Science and Engineering: Com	pulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	on Computer Science and Engineering: Com on Chemical Engineering: Compulsory on Bioprocess Engineering: Compulsory		
Assignment for the Following	General Engineering Science (German program): Specialisatic General Engineering Science (German program): Specialisatic General Engineering Science (German program): Specialisatic General Engineering Science (German program): Specialisatic	on Computer Science and Engineering: Com on Chemical Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Co	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation	on Computer Science and Engineering: Com on Chemical Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Co on Civil- and Enviromental Engeneering: Co	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic General Engineering Science (German program): Specialisatic	on Computer Science and Engineering: Com on Chemical Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Co on Civil- and Enviromental Engeneering: Con on Mechanical Engineering: Compulsory	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engeneering: Computer and Engineering:	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engeneering: Computer and Engineering:	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engeneering: Computer and Engineering:	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Com	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engeneering: Computer and Engineering:	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Compulsory	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engeneering: Computer and Engineering:	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory	ompulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Specialisatio General Engineering Science (English program): Specialisatio	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory	ompulsory mpulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Specialisatio General Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory Impulsory Im	ompulsory mpulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Cogeneral Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Compulsory on Energy and Environmental Engineering: Computer and Environmental Engineering: Computer and Environmental Engineering: Computer and Environmental Engineering: Compulsory on Naval Architecture: Compulsory pulsory Impulsory Impulsory In Civil- and Environmental Engeneering: Computer and Environmental Engeneeri	ompulsory mpulsory npulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Cogeneral Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio Genera	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Enviromental Engineering: Compulsory on Energy and Enviromental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory Impulsory In Civil- and Enviromental Engeneering: Compulsory on Bioprocess Engineering: Compulsory In Electrical Engineering: Compulsory In Electrical Engineering: Compulsory In Electrical Engineering: Compulsory In Energy and Enviromental Engineering: Compulsory	ompulsory mpulsory npulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Cogeneral Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio Genera	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory on Civil- and Environmental Engeneering: Compulsory on Dioprocess Engineering: Compulsory on Bioprocess Engineering: Compulsory on Electrical Engineering: Compulsory on Energy and Environmental Engineering: Compulsory on Computer Science and Engineering: Compu	ompulsory mpulsory npulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Cogeneral Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio Genera	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory on Civil- and Environmental Engeneering: Compulsory on Dioprocess Engineering: Compulsory on Bioprocess Engineering: Compulsory on Electrical Engineering: Compulsory on Energy and Environmental Engineering: Computer Science and Engineering: Computer Science an	ompulsory mpulsory npulsory	
Assignment for the Following	General Engineering Science (German program): Specialisatic Civil- and Environmental Engineering: Core qualification: Combioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Cogeneral Engineering Science (English program): Specialisatio General Engineering Science (English program): Specialisatio Genera	on Computer Science and Engineering: Computer Science and Engineering: Compulsory on Bioprocess Engineering: Compulsory on Energy and Environmental Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory on Naval Architecture: Compulsory pulsory on Civil- and Environmental Engeneering: Compulsory on Dioprocess Engineering: Compulsory on Electrical Engineering: Compulsory on Electrical Engineering: Compulsory on Computer Science and Engineering: Compulsory on Mechanical Engineering: Compulsory on Mechanical Engineering: Compulsory on Biomedical Engineering: Compulsory	ompulsory mpulsory npulsory	



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: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,
	using their knowledge from the corresponding lecture.
	Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0854: Mathematic	es IV			
Courses				
Title		Тур	Hrs/wk	CP
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential	Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential	Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
_	Students can name the basic concepts in Ma	thematics IV. They are able to explain them using app	ropriate examples.	
	 Students can discuss logical connections bet 	ween these concepts. They are capable of illustrating	g these connections w	ith the help of examples.
	 They know proof strategies and can reproduce 	ce them.		
Skills				
		s IV with the help of the concepts studied in this cours	se. Moreover, they are	e capable of solving them
	by applying established methods.			
	Students are able to discover and verify further	er logical connections between the concepts studied i	n the course.	
	 For a given problem, the students can develo 	p and execute a suitable approach, and are able to co	ritically evaluate the re	esults.
Personal Competence				
Social Competence				
,	 Students are able to work together in teams. 	They are capable to use mathematics as a common la	anguage.	
	 In doing so, they can communicate new con 	cepts according to the needs of their cooperating pa	rtners. Moreover, they	can design examples to
	check and deepen the understanding of their	peers.		
Autonomy				
·		erstanding of complex concepts on their own. They c	an specify open ques	tions precisely and know
	where to get help in solving them.			
	 Students have developed sufficient persisten 	ce to be able to work for longer periods in a goal-orie	nted manner on hard	problems.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 1	12		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Ed	quations 2)		
Assignment for the Following	General Engineering Science (German program): Sp	. ,		
Curricula		pecialisation Mechanical Engineering, Focus Mechatr	onics: Compulsory	
Ourricula		pecialisation Mechanical Engineering, Focus Mechanical Engineering, Focus Theoreti		eering: Compulsory
	General Engineering Science (German program): Sp		our mooriamoai Engin	.comg. compulsory
		' '		
	Computer Science: Specialisation Computational Ma	• •		
	Electrical Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Sp			
	General Engineering Science (English program): Sp	' '		
		ecialisation Mechanical Engineering, Focus Mechatro		
	[O F O - /F - O	ecialisation Mechanical Engineering, Focus Theoretic	cal Mechanical Engine	eering: Compulsory
	General Engineering Science (English program): Sp			
	Computational Science and Engineering: Specialisa	tion Engineering Sciences: Elective Compulsory		
	Computational Science and Engineering: Specialisa	Mechanical Engineering: Compulsory		
	Computational Science and Engineering: Specialisa Mechanical Engineering: Specialisation Theoretical	Mechanical Engineering: Compulsory		
	Computational Science and Engineering: Specialisa Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Mechatronic	Mechanical Engineering: Compulsory		



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations	
	Examples of partial differential equations	
	First order quasilinear differential equations	
	Normal forms of second order differential equations	
	Harmonic functions and maximum principle	
	Maximum principle for the heat equation	
	Wave equation	
	Liouville's formula	
	Special functions	
	Difference methods	
	Finite elements	
Literature	D. Assesse J. J. Obeda Mathematik fizikasariawa Pand O. Vada Milay VOJ. Padia Mainhain Nay Vad. 2000	
	R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 R. Haddid, B. Jakob (Karakara Asakari (Takararia and Bild)) R. Haddid, B. Jakob (Karakara Asakari (Takararia and Bild))	
	P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998	
	A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002	

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

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

Course L1038: Complex Functions	
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	Main features of complex analysis
	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	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998



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

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



Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillations, Ana	llytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
flechanics IV (Kinetics II, Oscillations, Ana	ulytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillations, Ana	ulytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mechanics I (Statics) and Mechanics III (Hydrostatics, Kin	nematics, Dynamics)		
Knowledge	Mathematics I and II			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students can			
-				
	describe the axiomatic procedure used in mecha	nical contexts;		
	 explain important steps in model design; 			
	 present technical knowledge. 			
Skills	The students can			
	explain the important elements of mathematical /	mechanical analysis and model formation, and ap	ply it to the context of	their own problems;
	 apply basic methods to engineering problems; 			
	 estimate the reach and boundaries of the method 	s and extend them to be applicable to wider proble	em sets.	
Personal Competence				
Social Competence	The students can work in groups and support each other	to overcome difficulties.		
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Speci	alisation Biomedical Engineering: Compulsory		
	General Engineering Science (German program): Speci	alisation Naval Architecture: Compulsory		
	General Engineering Science (English program): Specia	lisation Mechanical Engineering: Compulsory		
	General Engineering Science (English program): Specia	lisation Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specia	lisation Naval Architecture: Compulsory		
	Mechanical Engineering: Core qualification: Compulsor	,		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Compu	Isory		
	Theoretical Mechanical Engineering: Technical Comple	montary Course Caro Studios: Floative Compulsor	.,	

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



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

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



Module M1117: Fluid Mechanics for Naval Architects				
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics for Naval Architects (L02	31)	Lecture	3	4
Fluid Mechanics for Naval Architects (L04	26)	Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics and me	echanics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and ship hydrodynamics. Students can			
	scientifically outline the rationale of flow physics using mathematical models.			
0.11				
Skills	Students are able to apply fluid-engineering principle	, ,	cal systems. The lectu	ire enables the student to
	carry out fluid-engineering calculations on a scientific level.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3h			
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Naval Architecture: Compulsory		
Curricula	General Engineering Science (English program): Spec	cialisation Naval Architecture: Compulsory		
	Naval Architecture: Core qualification: Compulsory			

Course L0231: Fluid Mechanics for	Noval Avabitants
	Lecture
Hrs/wk	
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	Fundamentals of fluid dynamics, particularly
	1. Physical properties & definition of fluids 2. Dimensional analysis & similitude 3. Forces in fluids & fluid statics 4. Transport theorem (conservation of mass, momentum & energy) 5. Elementary dynamics along a streamline 6. Fluid kinematics 7. Potential flows & vortex flows 8. Analytical solutions of the Navier-Stokes equation 9. Turbulent flows & boundary-layer flows 10. Viscous flows in ducts and pipes 11. Flow over immersed bodies
Literature	J.H. Spurk, N. Aksel: Strömungslehre, Springer Verlag H. Schade, E. Kunz: Strömungslehre, Walter de Gruyter B. R. Munson, D.F. Young, T. H. Okiishi: Fundamental of Fluid Mechanics, John Wiley, 2006 (in Englis(c)h)

Course L0426: Fluid Mechanics for Naval Architects	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0640: Stochastics	s and Ship Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Ship Dynamics (L0352)		Lecture	2	3
Ship Dynamics (L1620)		Recitation Section (small)	1	1
Statistics and Stochastic Processes in Na	val Architecure and Ocean Engineering (L0364)	Lecture	2	3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous				
Knowledge	Technical mechanics			
	Linear algebra, analysis, complex numbers			
	Fluid mechanics			
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	- The students are able to give an overview over various n	nanoeuvres. They can name application goals	and they can desc	ribe the procedure of
	manoeuvres.			
	The etudente are able to give an evention everyoring rudd	or types. They can name evitoric in the rudder d	oolan	
	- The students are able to give an overview over varius ruddents	er types. They can name criteria in the rudder o	esign.	
	- The students can name computation methods which are us	ed to determine forces and motions in waves.		
Skills	- The students can come up with the equations of motions when the students can come up with the equations of motions when the students can come up with the equations of motions when the students can come up with the equations of motions when the students can come up with the equations of motions when the students can come up with the equations of motions when the students can come up with the equations of motions when the equations of motions where the equations of motions where the equations of the equation of the equations of the equation of the equations of the equations of the equation	nich are used to discribe manoeuvres. The can	use and linearise th	em.
	- The students are able to determine hydrodynamic coefficien	nts and they can explain their physical meaning].	
		avaleia the aboveical offects which are according		
	- The students can explain how a rudder works and they can	explain the physical effects which can occur.		
	- The students can mathematically describe waves.			
	- The students can explain the mathematically description of	harmanaial matiana in wayse and they can dat	armina tham	
	- The students can explain the mathematically description of	namondal motions in waves and they can det	emine trem.	
Personal Competence				
Social Competence	- The students can arrive at work results in groups and docu	ment them.		
	The etudente can discuss in groups and evalois their point	of view		
	- The students can discuss in groups and explain their point	or view.		
Autonomy	- The students can assess their own strengthes and weaknes	sses and the define further work steps on this b	asis.	
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester		ry	
	General Engineering Science (English program): Specialisa	•	-	
	General Engineering Science (English program, 7 semester		ν	
	Naval Architecture: Core qualification: Compulsory		-	



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

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



Course L0364: Statistics and Stocha	astic Processes in Naval Architecure and Ocean Engineering
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, John Wiley & Sons, Inc., New York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and Statistics, Springer, 2005 Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006 A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013



Module M0655: Computation	and Elvid Dynamica I			
Module M0655: Computation	onal Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L0235)		Lecture	2	3
Computational Fluid Dynamics I (L0419)		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Mathematical Mathematicas Facilities			
Knowledge	Mathematical Methods for Engineers - Fundamentals of Differential forteness and applications.			
	 Fundamentals of Differential/integral calculus and ser 	res expansions		
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial diffe	erential equations.		
Skills	The students are able develop appropriate numerical integ	gration in space and time for the governing	partial differential ed	quations. They can code
	computational algorithms in a structured way.			
B				
Personal Competence				
Social Competence	The students can arrive at work results in groups and docume	ent them.		
A. t	The state of the s	San and Maria Maria		
Autonomy	The students can independently analyse approaches to solving specific problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Mechanical Engineering, Focus Energy S	systems: Compulsory	
Curricula	General Engineering Science (German program): Specialisa			
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulso	ory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Foo	us Energy Systems: I	Elective Compulsory
	General Engineering Science (English program): Specialisat	ion Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisat	ion Mechanical Engineering, Focus Energy S	ystems: Compulsory	
	General Engineering Science (English program, 7 semester)	: Specialisation Naval Architecture: Compulso	ry	
	General Engineering Science (English program, 7 semester)	: Specialisation Mechanical Engineering, Foc	us Energy Systems: E	Elective Compulsory
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

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



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



Module M0659: Fundamen	tals of Ship Structural Design and Analysis			
Courses				
Title		Typ	Hrs/wk	CP
Fundamentals of Ship Structural Design (I	0411)	Typ Lecture	2 2	2
Fundamentals of Ship Structural Design (I		Recitation Section (small)	1	2
Fundamentals of Ship Structural Analysis		Lecture	2	2
Fundamentals of Ship Structural Analysis		Recitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers	,		
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
	Tandanichtais or Wedhanidar Besign Tim			
Edward and Obligation	Affairle Committee of the state	to the contract of the		
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	Students can reproduce the basic contents of the structural be	ehaviour of ship structures; they can explain	the theory and meth	ods for the calculation of
	deformations and stresses in beam-like structures.			
	Furthermore, they can reproduce the basis contents of code	c (rulae) materials semi-finished products	ioining and principle	se of etructural decian of
	components in the ship structure.	(rules), materials, semi-imistred products,	joining and principle	sa or andeteral design t
	components in the strip structure.			
Skills	Students are capable of applying the methods and tools for the	e calculation of linear deformations and stre	esses in the above m	entioned structures; the
	can choose calculation models of typical ship structures.			
	Furthermore they are conclude a confusting methods of drawing	a and sizing the chip atrusture; they can ac	laat auitabla matarial	a comi finished product
	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.			
	and joints.			
Personal Competence				
Social Competence	The students are able to communicate and cooperate in a prof	essional environment in the shipbuilding and	d component supply i	ndustry.
Autonomy	The students are capable to independently idealize real ship	a structures and to coloct quitable mathada	for analysis of beam	like etrueturee they er
Autonomy		structures and to select suitable methods	ioi alialysis oi beali	i-like structures, triey are
	capable to assess the results of structural analyses.			
	Furthermore, they are capable to assess drawings of comple	ex ship structures and to design ship struc	tures for various requ	uirements and boundar
	conditions.			
Workload in Hours	Independent Study Time 156, Study Time in Lecture 84			
Credit points	8			
Examination				
	Written exam			
Examination duration and scale	3 hours	Nevel Architecture Committee		
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program, 7 semester):		ory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester):	Specialisation Naval Architecture: Compulso	ry	
	Naval Architecture: Core qualification: Compulsory			



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

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

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



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



Module M0664: Structural I	Design and Construction of Ships			
Courses				
Title		Тур	Hrs/wk	CP
Ship Structural Design (L0412)		Lecture	2	3
Ship Structural Design (L0415)		Recitation Section (small)	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have reached the following learn	ning results		
Professional Competence				
Knowledge	Students can reproduce design and sizing as well as fabrication of the they can describe calculation models for complex structures.	e different areas of ship structures	and of different ship ty	rpes (incl. detail design)
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for the components, to select suitable calculation models and to assess the chosen structure			
Personal Competence Social Competence				
Autonomy	Students are capable to design independently different structural are methods.	as of the ship hull and different s	hip types and to defind	e appropriate fabrication
World of the United				
Workload in Hours	Independent Study Time 172, Study Time in Lecture 98			
Credit points	9			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation Naval			
Curricula	General Engineering Science (German program, 7 semester): Specialis	sation Naval Architecture: Compuls	sory	
	General Engineering Science (English program): Specialisation Naval			
	General Engineering Science (English program, 7 semester): Specialis	sation Naval Architecture: Compuls	ory	
	Naval Architecture: Core qualification: Compulsory			



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

Course L0415: Ship Structural Design		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	SoSe	
Content	Chapters:	
	1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	



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



Module M1118: Hydrostation	es and Body Plan				
Courses					
Title		Тур	Hrs/wk	СР	
Hydrostatics (L1260)		Lecture	2	3	
Hydrostatics (L1261)		Recitation Section (large)	2	1	
Body Plan (L1452)		Project Seminar	2	2	
Module Responsible	Prof. Stefan Krüger				
Admission Requirements	None				
Recommended Previous	Good knowledge in Mathemathics I-III and Mechanics	s I-III.			
Knowledge	It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan, GA- Plan, Tank Plan etc.				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge					
	all following lectures in the subjects shipo design and	I safety of ships.			
0.111					
Skills	The student is able to carry out hydrostatic calculation	ns to ensure that the snip has sufficient stability. He i	s able to design null to	orms that are sate again	
	capsizing or sinking.				
Personal Competence					
Social Competence	The student gets access to hydrostatical problems.				
Autonomy					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	4			
Credit points	6				
Examination	Written exam				
Examination duration and scale	180 min				
Assignment for the Following	General Engineering Science (German program): Sp	ecialisation Naval Architecture: Compulsory			
Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Naval Architecture: Compul-	sory		
	General Engineering Science (English program): Spe	ecialisation Naval Architecture: Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Naval Architecture: Compuls	sory		
	Naval Architecture: Core qualification: Compulsory				

Course I 1000 - Undreadable			
Course L1260: Hydrostatics	Lastura		
Typ Hrs/wk	Lecture 2		
CP			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Stefan Krüger		
Language	DE		
Cycle	SoSe		
Content	Numerical Integration, Diffrentation, Interpolation		
	- Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods		
	- Determination of Areas, 1st and 2nd order Moments		
	- Numerical Diffrentation, Spline Interpolation		
	2. Buyoancy		
	- Principle of Archimedes		
	- Equlibrium Floating Condition		
	- Equlibrium Computations		
	- Hydrostatic Tables and Sounding Tables		
	- Trim Tables		
	3. Stability at large heeling angles		
	- Stability Equation		
- Cross Curves of Stability and Righting Levers			
	- Numerical and Graphical Determination of Cross Curves		
	- Heeling Moments of Free Surfaces, Water on Deck, Water Ingress		
	- Heeling Moments of Different Type		
	- Balance of Heeling and Righting Moments acc. to BV 1030		
	- Intact Stability Code (General Critaria)		
	4. Linearization of Stability Problems		
	- Linearization of Restoring Forces and Moments		
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- Correlation between Metacentric Height and Righting Lever at small heeling angles
- Computation of Path of Metacentric Height for Modern Hull Forms
- Correlation between Righting Lever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix
- Definition of MCT
- Computation of Equilibrum Floating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Initial GM
- Roll Motions at Small Roll Angles
- 6. Stability in Waves
- Roll Motions at Large Amplitudes
- Pure Loss of Stability on the Wave Crest
- Principle of Parametric Excitation
- Principle of Direct Wave Moments
- Grim's Equivalent Wave Concept
- 6 Longitudinal Strength
- Longitudinal Mass Distribution, Shear Forces, Bending Moments
- Longitudinal Strength in Stability Booklet
- 7. Deadweight Survey and Inclining Experiment
- Deplacement Computations from Draft mark Readings
- Weights to go on /come from board
- Inclining Experiment with Heeling Moments from Weights and Heeling Tanks
- Residual Sounding Volumes
- Determination of COG from Metacentric height and from Cross Curves
- Roll Decay Test
- 8. Launching and Docking
 - Launching Plan, Arrangement of Launching Blocks
 - Rigid Body Launching: Tilting, Dumping, Equation of Techel
- Computation of Launching Event
- Bottom Pressure and Longitudinal Strength
- Linear- Elastic Effects
- Transversal Stability on Slipway and in Dock
- 9. Grounding
- Loss of Buoynacy when Grounded
- Pointwise Grounding
- Ship Grounds on Keel
- 10. Introduction into Damage Stability Problems
- Added Mass Method
- Loss of Buoyant Volume Method
- Simple Equilibrium Computations
- Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
- Water Ingress Through Openings
- 11. Special Problems (optional and agreed upon)
- e.g. Heavy Lift Operations
- e.g. Jacking of Jackup Vessels
- e.g. Sinking After Water Ingress

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



2. Henschke
Schiffstechnisches Handbuch, Band 1
VEB Technik Verlag Berlin
3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

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

Course L1452: Body Plan	
Тур	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of: - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig 2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin 3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.



Module M1109: Resistance	and Propulsion			
Courses				
Title		Тур	Hrs/wk	CP
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mechanics			
	Fluid Dynamics for Naval Architects			
	Hydrostratics			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for resistance and pr	opulsion of ships are discussed. The diffe	erent resistance pheno	mena and their practica
	applications to hullform design as well as numerical and empiri	cal prediction methods are subject of the	course. Furthermore,	environmental additiona
	resistances are dealt with. The course includes model test to	chniques and their application to full s	cale ships. This hold	also for propulsion and
	hullefficiency elements, mainly thrust deduction and wake. I	Main Focus is how hull forms can be	optimized for minimu	m and sustainable fue
	consumption. The following topics are dealt with:			
	Office the football and a state of the state	formation and the second secon	and the destruction for	and the section of th
	- 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, thrus			
	deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power			
	predictions, additional resistances (wind, steering, current, sea s	tate), EEDI, speed trials, contractual matte	ers concerning speed/p	oower, bunker claims
Skills	The student shall learn to design competitve 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				
Social Competence	The student learns to prepare technical matters in such a way the	at he can compte with his building suvervi	sion team.	
Autonomy	The student learns to prepare technical matters in such a way the	at he can compte with his building suvervi	sion team.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Naval Architecture: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architecture: Compuls	sory	
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture: Compuls	ory	
	Naval Architecture: Core qualification: Compulsory			

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



Module M1110: Ship Design	n			
Courses				
Title		Тур	Hrs/wk	СР
Ship Design (L1262)		Lecture	2	3
Ship Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	5			
Knowledge	 Fluid Dynamics for Naval Architects, Resistance and Propulsi Resistance and Propulsion, Hydrostatics 	on		
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the importance and req	uirements of the aerly design pha	se. Competitive Eleme	nts of Ship Designs are
	thoroughly discussed. Typical bulding contracts and the related to	echnical risk are introduced. The	most important main pa	arameters of a ship are
	introduced and their influence on the competitiveness of a design.	The lecture focusses on the influe	ence of alternated main	parameters on the total
	performance of a ship design and the consecutive process element	s. In this lecture, the design chang	es are dealt with by sim	ple models or formulae.
	The student shall further learn to model complex systems properly so	that the relavent technical conclusi	ons can be drawn.	
	The lecture continues with an introduction into the different phases of	design project, from the initial design	gn phase to a building c	ontract. Further, methods
	are introduced to generate bulding specfication relevant information			
	following topics are adressed:		•	
	- Structure of a building specification			
	- Determination of Light Ship Weight and Deadweight			
	Components			
	- Design of main section and hull form			
	- Design of aftbody lines and manoevering devices			
	- Design of main propulsion plant			
	- Design of subdivision			
	- Determination of limiting GMrequ- Curves			
	- Scantlings of most improtant structural members - Longitudinal strength			
	- Outlitting Components			
	- Relevant rules and regulations			
Skills	The student is made familiar with the basic design principles of sea			
	carry out a concept design based on a vessel of comparison fulfilling			
	the basic design methods to determine the fundamantal technical cl			
	values. Based on the lecture "Principles of Ship Design" the relevant	methods to determine and judge uc	opn the performance of a	ship design are treated.
Personal Competence				
Social Competence	The students learns to prepare technical matters in such a way the he	e can persuade his potantial custom	ner against his competito	rs.
Autonomy	The students learns to prepare technical matters in such a way the he	e can persuade his potantial custom	ner against his competito	rs.
Workland in Harris	Independent Study Time 124 Study Time in Leature 55			
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Nav	ral Architecture: Compulsorv		
Curricula	General Engineering Science (German program, 7 semester): Specia		Isory	
2	General Engineering Science (English program): Specialisation Nava		,	
	General Engineering Science (English program, 7 semester): Specia		sory	
	Naval Architecture: Core qualification: Compulsory		-	

Course L1262: Ship Design	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	
Literature	



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



Specialization Bioprocess Engineering

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

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

Module M0886: Fundamen	tals of Process Engineering				
Courses					
Title		Тур	Hrs/wk	CP	
Introduction into Process Engineering/Biop	process Engineering (L0829)	Lecture	2	1	
Fundamentals of Technical Drawing and N		Lecture	1	1	
Fundamentals of Technical Drawing and M	Materials (L1495)	Recitation Section (large)	1	2	
Environmental Technologie (L0326)		Lecture	2	2	
Module Responsible	Prof. Michael Schlüter				
Admission Requirements	none				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the	e following learning results			
Professional Competence					
Knowledge	After passing this module the students have the ability	to:			
	Color of the control				
	give an overview of the most important fields or				
	 explain some working methods for different field 	ds in process engineering.			
Skills	After passing this module the students should have the	ability to:			
	list and outline the most important fields of proc				
	 name the most important working approaches or methods of the different fields of process engineering, 				
	read and prepare an engineering drawing,				
	explain the most important technologies for wastewater and exhaust air treatment				
	scheme typical chemical and biotechnological	processes independently with the aid of pointers.			
Personal Competence					
Social Competence	The students are able to				
	work out results in groups and document them,				
	 provide appropriate feedback and handle feedback 	back on their own performance constructively.			
Autonomy	The students are able to estimate their progress of	learning by themselves and to deliberate their la	ack of knowledge in F	rocess Engineering a	
·	Bioprocess Engineering.		-		
	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following	General Engineering Science (German program): Spec	cialisation Chemical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Spec	cialisation Bioprocess Engineering: Compulsory			
	Bioprocess Engineering: Core qualification: Compulso	ry			
	General Engineering Science (English program): Spec	ialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (English program): Spec	ialisation Chemical Engineering: Compulsory			
	Technomathematics: Specialisation Engineering Scien	ice: Elective Compulsory			
	Process Engineering: Core qualification: Compulsory				



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

Course L0830: Fundamentals of Teo	chnical Drawing and Materials
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards) Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)
	 Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011 Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013 Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course L1495: Fundamentals of Technical Drawing and Materials	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L0326: Environmental Technologie		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)	



Module M0536: Fundament	tals of Fluid Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Fluid Mechanics (L0091)		Lecture	2	4
Exercises in Fluid Mechanics for Process		Recitation Section (large)	1	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous				
Knowledge	Working with force balances			
	Simplification and solving of partial differential equations			
	Integration			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to:			
	explain the difference between different times of flow.			
	explain the difference between different types of flow give an overview for different applications of the Reynolds	Transport Theorem in process angines	oring	
	explain simplifications of the Continuity- and Navier-Stoke			
	- Oxplain simplifications of the Continuity and Navior Clore	5 Equation by using physical boundary	Conditions	
Skills	The students are able to			
	 describe and model incompressible flows mathematically 			
	reduce the governing equations of fluid mechanics by sim	olifications to archive quantitative solution	ons e.g. by integration	
	notice the dependency between theory and technical app	•	one eig. by integration	
	use the learned basics for fluid dynamical applications in			
	, , , ,			
Personal Competence				
Social Competence	The students			
	 are capable to gather information from subject related, pro 	fessional publications and relate that in	formation to the context	of the lecture and
	able to work together on subject related tasks in small gro	ups. They are able to present their resu	Its effectively in English	(e.g. during small grou
	exercises)			
Autonomy	The students are able to			
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 138, Study Time in Lecture 42			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following		Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation			
Garricula	General Engineering Science (German program): Specialisation		Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory		paioo.j	
	Energy and Environmental Engineering: Core qualification: Comp	pulsory		
	General Engineering Science (English program): Specialisation I	•		
	General Engineering Science (English program): Specialisation I		Compulsory	
	General Engineering Science (English program): Specialisation (**		
	Technomathematics: Specialisation Engineering Science: Electiv	e Compulsory		



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

Course L0092: Exercises in Fluid Me	echanics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For
	this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems
	in Process Engineering.
Literature	Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.
	Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.
	3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994
	 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006
	5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
	6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007
	7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009
	8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007
	9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008
	10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006
	11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.
	12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011



Module M0757: Biochemist	ry and Microbiology			
Courses				
Title		Тур	Hrs/wk	CP
Biochemistry (L0351)		Lecture	2	2
Biochemistry (L0728)		Problem-based Learning	1	1
Microbiology (L0881)				2
Microbiology (L0888)		Problem-based Learning	1	1
Module Responsible	Prof. Rudolf Müller			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence		<u> </u>		
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical research to determine	e the properties of biomolecules		
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Skills				
Personal Competence				
Social Competence	The students are able,			
	- to gather knowledge in groups of about 10 students			
	- to introduce their own knowledge and to argue their view in discussions i	in teams		
	- to divide a complex task into subtasks, solve these and to present the cor	mbined results		
Autonomy	The students are able to present the results of their subtasks in a written re	eport		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Bioproce	ess Engineering: Compulsory		
Curricula	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Bioproces	ss Engineering: Compulsory		
ļ.	Technomathematics: Specialisation Engineering Science: Elective Compu	ulsory		



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

Course L0728: Biochemistry		
Тур	Problem-based Learning	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Rudolf Müller	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



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

Course L0888: Microbiology		
Тур	Problem-based Learning	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Kerstin Sahm	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0544: Phase Equi	ilibria Thermodynamics			
courses				
itle		Тур	Hrs/wk	CP
hermodynamics III (L0114)		Lecture	2	2
hermodynamics III (L0140)		Recitation Section (small)	1	2
hermodynamics III (L0142)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Thermodynamics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	 Starting from the very basics of thermodynamics, the They learn how state variables are influenced by the Moreover, the students learn how phase equilibria c liquid, solid) coexist in equilibrium. Furthermore the f For different phase equilibria, several examples rele interpreting the equilibria are taught. 	mixing of compounds and learn concepts to quan be described mathematically and which phundamentals of reaction equilibria are taught.	uantitatively describe enomena may occur	these properties. If different phases (vap
Skills	 Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know how simplify these equations meaningfully. The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve the resulting mathematical relations. For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameters literature sources. Beside pure compound properties the students are capable of describing the properties of mixtures. The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena. Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reaction processes in chemical engineering. 			
Personal Competence Social Competence Autonomy	,			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Control and Soule	· · · · · · · · · · · · · · · · · · ·	otion Chamical Engineering Community		
A a a law man a mark of a collection of the collection of	General Engineering Science (German program): Specialisa			
Assignment for the Following	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory			
Assignment for the Following Curricula		ation bioprocess Engineering. Compaisory		
	General Engineering Science (German program): Specialisa Bioprocess Engineering: Core qualification: Compulsory	and bioprocess Engineering. Compaisory		
	Bioprocess Engineering: Core qualification: Compulsory	tion Bioprocess Engineering: Compulsory		



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

Course L0140: Thermodynamics III	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. G ^E -Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Course L0142: Thermodynamics III		
Тур	Recitation Section (large)	
Hrs/wk		
CP		
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	SoSe	
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure	
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 	



Module M0672: Signals and	l Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0432)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(1.3.,		
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,	*	•	•
			<u> </u>	
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear	(,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I	•	in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sig	•	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and fre	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	·	ntrol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system	1.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation Computer Science: Core qualification: Compulsory	Biomedical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Civil- and Environmental Engangering: Co	ompuleony	
	General Engineering Science (English program): Specialisation		лпривогу	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsorv	
	General Engineering Science (English program): Specialisation		,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electi	ve Compulsory		



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

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



Module M0829: Foundation				
Courses				
litle little		Тур	Hrs/wk	СР
ntroduction to Management (L0880)		Lecture	4	4
Project Entrepreneurship (L0882)	Det Object the	Problem-based Learning	2	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reached the following learnin	a results		
Professional Competence	3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	9		
Knowledge	After taking this module, students know the important basics of many diff Marketing and Innovation, and also to Investment and Controlling. In parti		nagement, from Plan	ning and Organisation
	explain the differences between Economics and Management and field of Management explain the most important aspects of and goals in Management a			
	describe and explain basic business functions as production, pro- ressource management, information management, innovation management, innovation management, innovation management, in Busing and decision making in Busing	nagement and marketing		
	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 Entrepreneurship project in a team. In particular, they are able to	ent criteria (organization, obje	ctives, strategies etc	.) and to carry out a
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives, under the control of the contr			
	analyse production and procurement systems and Business inform analyse and apply basic methods of marketing.	nation systems		
	 analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to pred 	efined problems		
	apply basic methods from accounting, costing and controlling to proceed the state of the st			
		•		
Personal Competence Social Competence				
	e work augescafully in a team of students			
	work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship p	roject and write a coherent renor	t on the project	
	to communicate appropriately and	roject and write a conferent repor	ton the project	
	to cooperate respectfully with their fellow students.			
Autonomy				
	work in a team and to organize the team themselves			
	to write a report on their project.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination				
Examination duration and scale				
Assignment for the Following		I Engineering: Compulsory		
Curricula			npulsory	
	General Engineering Science (German program): Specialisation Chemica	al Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Bioproce	ess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation Energy a	and Enviromental Engineering: C	Compulsory	
	General Engineering Science (German program): Specialisation Civil- an		ompulsory	
	General Engineering Science (German program): Specialisation Mechani			
	General Engineering Science (German program): Specialisation Biomedi			
	General Engineering Science (German program): Specialisation Naval Al Civil- and Environmental Engineering: Core qualification: Compulsory	omediare. Compuisory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Civil- and	I Enviromental Engeneering: Co	mpulsory	
	General Engineering Science (English program): Specialisation Bioproce	ss Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Electrical	Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Energy a			
	General Engineering Science (English program): Specialisation Compute		npulsory	
	General Engineering Science (English program): Specialisation Mechanic			
	General Engineering Science (English program): Specialisation Biomedic General Engineering Science (English program): Specialisation Naval Ar			
	General Engineering Science (English program): Specialisation Navai And General Engineering Science (English program): Specialisation Chemica			
	and a second control (English program). Openial auton Offernica	gog. compulsory		

Process 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

Course L0880: Introduction to Mana	gement
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting; Accounting, Balance-Sheets, Costing
	Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008
	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.
	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.
	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course L0882: Project Entrepreneu	rship
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,
	using their knowledge from the corresponding lecture.
	Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0938: Bioprocess	Engineering - Fundamentals			
Courses				
Title		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (1.0841)	Lecture	2	3
Bioprocess Engineering- Fundamentals (L		Recitation Section (large)	2	1
Bioprocess Engineering - Fundamental Pr		Laboratory Course	2	2
Module Responsible	Prof. Andreas Liese	·		
Admission Requirements	none			
Recommended Previous	none, module "organic chemistry", module "fundamentals for p	process engineering"		
Knowledge	, , , , , , , , , , , , , , , , , , ,	3 3		
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence	The many part occoording, state in the reasoned are issued	g rearring receive		
Knowledge	Students are able to describe the basic concepts of biopro	coss anginogring. They are able to classif	iv different types of k	inotice for onzymos and
Knowledge	microorganisms, as well as to differentiate different types of in			
	processes in bioreactors can be explained. The students are			
	downstream processing in detail.	e capable to explain lundamental bioproce	sss management, ste	illization technology and
	downstream processing in detail.			
Skills	After successful completion of this module, students should be	able to		
	describe different kinetic approaches for growth and su			
	predict qualitatively the influence of energy generation		vth inhibition on the fe	rmentation process
	analyze bioprocesses on basis of stoichiometry and to			
	distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as			
	well as to apply them to current biotechnical problem			
	propose solutions to complicated biotechnological pro	olems and to deduce the corresponding mod	dels	
	to explore new knowledge resources and to apply the	newly gained contents		
	identify scientific problems with concrete industrial use and to formulate solutions.			
	- Identify scientific problems with controls industrial asc	and to formulate solutions.		
Personal Competence				
·	After a contest of the contest of th	and the standard section of the second section of	An and have a state of 199	
Social Competence	After completion of this module participants should be able to		to enhance the abilit	y to take position to thei
	own opinions and increase their capacity for teamwork in engi	neering and scientific environments.		
Autonomy	After completion of this module participants will be able to	solve a technical problem in a team indep	endently by organizir	ng their workflow and to
	present their results in aplenum.			.9
	process them recented an appendum			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisati	on Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisati	on Bioprocess Engineering: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	on Chemical Engineering: Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs and F			
	Biomedical Engineering: Specialisation Implants and Endopro			
	Biomedical Engineering: Specialisation Medical Technology a	· ·		
	Biomedical Engineering: Specialisation Management and Bus			
	Technomathematics: Specialisation Engineering Science: Ele			
	Process Engineering: Core qualification: Compulsory	ouve computating		
	Frocess Engineering. Core qualification: Compulsory			



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

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

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



Module M0538: Heat and N	lass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	4
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	,			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		learning results		
Knowledge				
·	The students are capable of explaining qualitative and d	letermining quantitative heat transfer in	procedural apparatu	s (e. g. heat exchange
	chemical reactors).	kinds of boot transfer mashanisms nam	alv boot conduction.	and transfer and there
	 They are capable of distinguish and characterize different radiation. 	kinds of fleat transfer flectianisms flam	ery near conduction, i	ieat transier and trieni
	The students have the ability to explain the physical basis	for mass transfer in detail and to describ	e mass transfer quali	tative and quantitative
	using suitable mass transfer theories.			4
	They are able to depict the analogy between heat- and ma	ss transfer and to describe complex linke	ed processes in detail	
Skills				
	The students are able to set reasonable system boundaring	es for a given transport problem by usi	ng the gained knowle	edge and to balance t
	corresponding energy and mass flow, respectively.	. (:da\ ==d += ==l=:/l=+= 4
	 They are capable to solve specific heat transfer problems corresponding heat flows. 	s (e.g. neated chemical reactors, temper	ature alteration in tiu	ids) and to calculate t
	Using dimensionless quantities, the students can execute s	scaling up of technical processes or appa	aratus.	
	They are able to distinguish between diffusion, convective			ledge for the descripti
	and design of apparatus (e.g. extraction column, rectification			,
	In this context, the students are capable to choose and	I design fundamental types of heat an	d mass exchanger f	or a specific applicat
	considering their advantages and disadvantages, respective	vely.		
	In addition, they can calculate both, steady-state and non-state an	teady-state processes in procedural app	aratus.	
	The students are capable to connect their knowledge of			In particular the cours
	thermodynamics, fluid mechanics and chemical process er	ngineering) to solve concrete technical p	roblems.	
Personal Competence				
Social Competence				
	The students are capable to work on subject-specific chall	enges in teams and to present the resul	ts orally in a reasona	ble manner to tutors a
	other students.			
Autonomy				
Autonomy	The students are able to find and evaluate necessary inform	mation from suitable sources		
	They are able to prove their level of knowledge during	the course with accompanying proce	dure continuously (d	clicker-system, exam-l
	assignments) and on this basis they can control their learning	ing processes.		
Wedder d'e Herre	Industrial Challer Transfer Age Challer Transfer Land and Age			
Workload in Hours Credit points				
Examination				
Examination duration and scale				
Assignment for the Following		Process Engineering: Compulsory		
Curricula				
	General Engineering Science (German program): Specialisation E	energy and Enviromental Engineering: C	ompulsory	
	General Engineering Science (German program, 7 semester): Spe	cialisation Process Engineering: Compu	ılsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Bioprocess Engineering: Cor	npulsory	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Energy and Enviromental En	gineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	·		
	General Engineering Science (English program): Specialisation B		mnulaa	
	General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation P		ompulsory	
	General Engineering Science (English program, 7 semester): Spe		Isorv	
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe			y
	Technomathematics: Specialisation III. Engineering Science: Elect	• • • • • • • • • • • • • • • • • • • •		
	Technomathematics: Core qualification: Elective Compulsory			
	I Book of Francisco Community of the Com			

Process Engineering: Core qualification: Compulsory



Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas	

Course L0102: Heat and Mass Transfer		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	Heat transfer	
	Introduction, one-dimensional heat conduction	
	Convective heat transfer	
	Multidimensional heat conduction	
	Non-steady heat conduction	
	Thermal radiation	
	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	
	The students work on tasks in small groups and present their results in front of all students.	
Literature	4 LLD Doobs and V Charless Williams and Chaffills also are Collisions	
	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer	
	2. VDI-Wārmeatlas	
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Module M0546: Thermal Se	paration Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge	rrecommended requirements. Trienhodynamics in			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge				
Knowieage	 The students can distinguish and describe different types o 	f separation processes such as distillation	n, extraction, and ads	sorption
	The students develop an understanding for the course of	concentration during a separation proces	ss, the estimation of	the energy demand of a
	process, the possibilities of energy saving, and the selectio			
	They have good knowledge of designing methods for sepa			
	τ, α τ ζετε τ τ τ ζετε τ τ τ ζ	,		
Skills				
Onno	 Using the gained knowledge the students can select a reas 	sonable system boundary for a given sepa	aration process and	can close the associated
	energy and material balances			
	The students can use different graphical methods for the de-	esigning of a separation process and defir	ne the amount of the	oretical stages required
	They can select and design a basic type of thermal sepa			
	process		-	•
	The students are capable to obtain independently the need	led material properties from appropriate s	ources (diagrams an	id tables)
	They can calculate continuous and discontinuous processes.		ourooo (ulugramo ur	(4.00)
	The students are able to prove their theoretical knowledge The students are able to discuss the theoretical background. The students are able to discuss the theoretical background.			
	The students are able to discuss the theoretical background	a and the content of the experimental work	k with the teachers in	i colloquium.
	The students are capable of linking their gained knowledge with	the content of other lectures and use it to	gether for the solution	on of technical problems.
	Other lectures such as thermodynamics, fluid mechanics and chen			·
Personal Competence				
Social Competence	The students can work technical assignments in small grounts.	ns and present the combined results in th	e tutorial	
	The students can work technical assignments in small grou	ps and present the combined results in th	e tatoriai	
	The students are able to some subsection like week as	all arrays and arraying a functional divi		- than Thanas all a
	The students are able to carry out practical lab work in sm		sion of labor betwee	n them. They are able to
	discuss their results and to document them scientifically in	a report.		
Autonomy				
7.6.6.1.9	The students are capable to obtain the needed information from suitable sources by themselves and assess their quality			
	The students can proof the state of their knowledge with ex-	am resembling assignments and in this w	ay control their learn	ing process
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation P	rocess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation B	ioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation E		mpulsory	
	General Engineering Science (German program, 7 semester): Spe	0,		
	General Engineering Science (German program, 7 semester): Spe		•	
			•	v
	General Engineering Science (German program, 7 semester): Spe	oranisation Energy and Environmental Engl	meening. Compuisor	у
	Bioprocess Engineering: Core qualification: Compulsory	day.		
	Energy and Environmental Engineering: Core qualification: Compr	•		
	General Engineering Science (English program): Specialisation Bi			
	General Engineering Science (English program): Specialisation Engineering	nergy and Enviromental Engineering: Cor	npulsory	
	General Engineering Science (English program): Specialisation Pr	rocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester): Spec	cialisation Process Engineering: Compuls	sory	
	General Engineering Science (English program, 7 semester): Spec		•	
	General Engineering Science (English program, 7 semester): Spec		•	/
	Process Engineering: Core qualification: Compulsory	same and a service of the control of		•



Course L0118: Thermal Separation	Processes	
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes	
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry*s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann*s Enzyklopädie der Technischen Chemie 	



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



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



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



Module M0892: Chemical R	eaction Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Chemical Reaction Engineering (Fundame	ntals) (L0204)	Lecture	2	2
Chemical Reaction Engineering (Fundame		Recitation Section (large)	2	2
Experimental Course Chemical Engineerin		Laboratory Course	2	2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules mathematics I-III, phy	rsical chemistry, technical thermodynamics I+II as w	rell as computational r	nethods for engineers.
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of che	mical reaction engineering. They are able to point	out differences betwe	en thermodynamical and
	kinetical processes. The students have a strong ability	to outline parts of isothermal and non-isothermal ide	eal reactors and to des	scribe their properties.
Skills	After successful completion of the module, students are	able to:		
	- apply different computational methods to dimension is	cothermal and non-isothermal ideal reactors,		
	- determine and compute stable operation points for the	ese reactors,		
	- conduct experiments on a lab-scale pilot plants and d	ocument these according to scientific guidelines.		
Personal Competence				
Social Competence	After successful completition of the lab-course the stu	dents have a strong ability to organize themselfe	s in small groups to	solve issues in chemical
	reaction engineering. The students can discuss their su	bject related knowledge among each other and wit	th their teachers.	
Autonomy	The students are able to obtain further information an	d assess their relevance autonomously. Students	can apply their know	dege discretely to plan
	prepare and conduct experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Spec	sialisation Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Spec			
	General Engineering Science (German program, 7 sen	nester): Specialisation Process Engineering: Comp	ulsory	
	General Engineering Science (German program, 7 sem	, ,	•	
	Bioprocess Engineering: Core qualification: Compulsor	y	•	
	General Engineering Science (English program): Spec			
	General Engineering Science (English program): Spec	alisation Process Engineering: Compulsory		
	General Engineering Science (English program, 7 sem	ester): Specialisation Process Engineering: Compu	lsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Bioprocess Engineering: Con	npulsory	
	Process Engineering: Core qualification: Compulsory			

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



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

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

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

Literature

lecture notes Raimund Horn

skrint Frerich Keil

Books:

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



ırse L0244: Chemical Reaction E	Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer Language	Prof. Raimund Horn, Dr. Oliver Korup DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, iner
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mas concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, 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 thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standar heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemic equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanis microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pr exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integr method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, ralimiting 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 reactor single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stage 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 flor reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mol balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exotherm reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of t cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isotherm reactors, optimum temperature profile of a reactor)
Literature	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
i	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000



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



Courses				
itle		Тур	Hrs/wk	CP
ioprocess Engineering - Advanced (L11)	07)	Lecture	2	4
Bioprocess Engineering - Advanced (L11)	18)	Recitation Section (small)	2	2
Module Responsible	Prof. An-Ping Zeng			
Admission Requirements	none			
Recommended Previous	Content of module "Biochemical Engineering I"			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	After successful completion of this module, students should be	e able to		
	 describe and explain different kinetic approaches for g 	rowth and substrate-uptake		
	 identification of scientific problems with concrete indu 	strial use (cultivation of microorganisms and r	mammalian cells)	
	 describe and explain important downstreaming steps 	for proteins and their application as well as b	asic immobilization n	nethods
Skills	After successful completion of this module, students should be	e able to		
	- to identifiy scientific questions or possible practical probler	ns for concrete industrial applications (eg cu	Itivation of microorga	nisms and animal cell
	and to formulate solutions,			
	- To assess the application of scale-up criteria for different type	oes of bioreactors and processes and to appl	y these criteria to giv	en problems (anaerob
	aerobic or microaerobically)			
	- to formulate questions for the analysis and optimization of re	al biotechnological production processes app	propriate solutions,	
	To describe the effects of the energy generation, the regions	ration of reduction equivalents, and the grow	th inhibition of the he	havior of microorganics
	- To describe the effects of the energy generation, the regeneration of reduction equivalents, and the growth inhibition of the behavior of microorganisms and to the total fermentation process qualitatively			
	and to the lotal formation process qualitatively			
	- Establish material flow balance equations and solve them to determine the kinetic parameters of different approaches and to calculate immobilization			
	and activity yields ,			
	- to select process control strategies (batch, fed-batch, contin	uity) appropriately and to calculate bacic tyr	oc and ovaluate ther	•
	- to select process control strategies (batch, led-batch, contin	uity / appropriately and to calculate basic typ	es and evaluate thei	
Personal Competence				
Social Competence	After completion of this module participants should be able t	o debate technical questions in small teams	to enhance the abilit	v to take position to the
	own opinions and increase their capacity for teamwork.	,		, 10 10110
	, ,			
Autonomy	After completion of this module participants are able to aquin	e new sources of knowledge and apply their	knowledge to previou	usly unknown issues a
	to present these.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination duration and scale	Written exam			
Examination duration and scale	90 min General Engineering Science (German program): Specialisate	ion Bioprocess Engineering: Committee		
Assignment for the Following Curricula	General Engineering Science (German program): Specialisat		nnuleory	
Curricula	General Engineering Science (German program, 7 semester) Bioprocess Engineering: Core qualification: Compulsory	. эрескинации вторгосеss Engineering: Cor	iipuisury	
	General Engineering Science (English program): Specialisati	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):		pulsory	
	Technomathematics: Core qualification: Elective Compulsory	,g		
	Technomathematics: Specialisation III. Engineering Science:	Floative Compulariy		



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

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



Module M0539: Process an	d Plant Engineering I			
Courses				
Title		Тур	Hrs/wk	CP
Process and Plant Engineering I (L0095)		Lecture	2	2
Process and Plant Engineering I (L0096)		Recitation Section (large)	1	2
Process and Plant Engineering I (L1214)	Dest Cours Fire	Recitation Section (small)	1	2
Module Responsible	Prof. Georg Fieg			
Admission Requirements	none			
Recommended Previous	unit operation of thermal an dmechanical separation processes			
Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical process	es		
	specify linear component equations of complex chemical processes			
	explain linear regression and data reconcilliation problems			
	explain pfd-diagrams			
Skills	students are capable of			
	- formulation of mass and energy balance equations and estimation of	of product streams		
	- estimation of component streams of chemical plants using linear col	mponent 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				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following	General Engineering Science (German program): Specialisation Program	cess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Biop	process Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specia	alisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia	alisation Energy and Enviromental Eng	ineering: Elective Co	ompulsory
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Biop			
	General Engineering Science (English program): Specialisation Proc	0 0 1 7		
	General Engineering Science (English program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Specia			and the same
	General Engineering Science (English program, 7 semester): Specia	iisation Energy and Enviromental Engi	ineering: Elective Co	mpulsory
	Process Engineering: Core qualification: Compulsory			

Course L0095: Process and Plant Engineering I	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression



Module Manual B. Sc.	. "General Engineering Science (English program)"	TUHH xhnische Universität Hamburg-Ha
	Data reconciliation and data validation 3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation	
Literature		
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679	
	H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74	
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	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133	
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	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	
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P. Li, M. Flender, K. Löwe, G. Wo	zny, G. Fieg, Fett/Lipid	100(1998), Nr. 12	2, S. 528-534
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G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112

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

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

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

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

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



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



Module M0670: Particle Ted	chnology and Solids Process Engineering			
0				
Courses		T	Here finds	0.0
Title		Тур	Hrs/wk	СР
Particle Technology I (L0434) Particle Technology I (L0435)		Lecture Recitation Section (small)	2	3 1
Particle Technology I (L0440)		Laboratory Course	2	2
Module Responsible	Prof. Stefan Heinrich	,		
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	 name and explain processes and unit-operations of solids 	process engineering		
	characterize particles, particle distributions and to discuss.			
	, , ,			
Skills	Students are able to			
	choose and design apparatuses and processes for solids processes.	* *	ds properties of the pro	duct
	 asses solids with respect to their behavior in solids process document their work scientifically. 	sing steps		
	• document their work scientifically.			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with other students or scientific personal and to develop solutions for technical-scientific issue			nnical-scientific issues ir
	a group.			
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation F			
Curricula	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			
		e (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Spe	cialisation Energy and Enviromental E	ngineering: Compulsory	/
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	•		
	General Engineering Science (English program): Specialisation B			
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory			
	General Engineering Science (English program): Specialisation P			
	General Engineering Science (English program, 7 semester): Spe		•	
	General Engineering Science (English program, 7 semester): Spe			
	General Engineering Science (English program, 7 semester): Spe	cialisation Energy and Enviromental Er	igineering: Compulsory	
	Process Engineering: Core qualification: Compulsory			



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

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

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



Specialization Electrical Engineering

Module M0708: Electrical E	ngineering III: Circuit Theory and Transients			
Courses				
Title		Тур	Hrs/wk	CP
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating e	ectrical circuits. They know the Fourie	r series analysis of I	inear networks driven by
	periodic signals. They know the methods for transient analysis o	f linear networks in time and in freque	ncy domain, and the	y are able to explain the
	frequency behaviour and the synthesis of passive two-terminal-circ	uits.		
Skills	The students are able to calculate currents and voltages in linear	networks by means of basic methods, a	lso when driven by p	periodic signals. They are
	able to calculate transients in electrical circuits in time and frequen	cy domain and are able to explain the re	espective transient be	ehaviour. They 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 groups. They are	encouraged to present and discuss their	results within the gro	oup.
Autonomy	The students are able to find out the required methods for solving		-	
	lectures continuously by means of short-time tests. This allows the		ational objectives. T	hey can link their gained
	knowledge to other courses like Electrical Engineering I and Mathe	matics I.		
	Independent Study Time 110, Study Time in Lecture 70			
	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Specialisation E			
Curricula	General Engineering Science (German program): Specialisation M	echanical Engineering, Focus Mechatro	onics: 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 Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Elective	Compulsory		
	recimentationates. Specialisation Engineering Science. Elective	Compaisory		



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

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



Module M0567: Theoretical	Electrical Engineering I: Time-Independent Field	3		
Courses				
Title Theoretical Electrical Engineering I: Time-I		Typ Lecture	Hrs/wk	CP 5
Theoretical Electrical Engineering I: Time-		Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	Elektrotechnik I, Elektrotechnik II, Mathematik I, Mathematik II, Math	enauk III		
Recommended Previous Knowledge	Basic principles of electrical engineering and advanced mathematic	es		
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence		<u> </u>		
Knowledge				
Skills	Skills Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independent, electromagnetic field problem Furthermore, they are capable of applying a variety of methods that require solving Maxwell's Equations for more general problems. The students causess the principal effects of given time-independent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications.			olems. The students can ningful quantities for the
Personal Competence				
Social Competence				
Autonomy	Students are capable to gather necessary information from provided references and relate this information to the lecture. They are able to continual reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the lectures and exercises that are related 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			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation El	ectrical Engineering: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Ele	ctrical Engineering: Compulsory		
	Computational Science and Engineering: Specialisation Engineering	g Sciences: Elective Compulsory		
	Technomathematics: Specialisation Engineering Science: Elective	Compulsory		



Course Lordo. Theoretical Liectifican	Engineering I: Time-Independent Fields
Тур	Lecture
Hrs/wk 3	3
CP 5	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
	Prof. Christian Schuster
0 0	DE .
	SoSe
Content -	- Maxwell's Equations in integral and differential notation
-	- Boundary conditions
-	- Laws of conservation for energy and charge
-	- Classification of electromagnetic field properties
-	- Integral characteristics of time-independent fields (R, L, C)
-	- Generic approaches to solving Poisson's Equation
-	- Electrostatic fields and specific methods of solving
-	- Magnetostatic fields and specific methods of solving
-	- Fields of electrical current density and specific methods of solving
-	- Action of force within time-independent fields
-	- Numerical methods for solving time-independent problems
Literature -	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
-	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
-	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
-	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
-	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
-	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Typ Recitation Section (small) Hrawk 2 CP 1 Workload in Hours Independent Study Time 2, Study Time in Lecture 28 Lecturer Prof. Christian Schuster Language DE Cycle ScSc Content - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems Literature - G. Lehner, 'Elektromagnetische Feldtheorie: Für Ingenieure und Physiker', Springer (2010) - H. Henke, 'Elektromagnetische Felder: Theorie und Anwendung'', Springer (2011) - W. Nolting, ''Cundkurs Theoretische Physik' 3: Elektrodynamik', Springer (2011) - D. Griffiths, 'Introduction to Electromagnetics', Mcgraw-Hill (2013) - Richard Feynman, 'Feynman Lectures on Physics: Volume 2', Basic Books (2011)	Course L0181: Theoretical Electrical	Il Engineering I: Time-Independent Fields
Workload in Hours Lecturer Prof. Christian Schuster Language DE Cycle SoSe Content	Тур	Recitation Section (small)
Lecture	Hrs/wk	2
Lecturer Language DE Cycle SoSe Content	СР	1
Language Cycle SoSe Content - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems Literature - G. Lehner, "Elektromagnetische Feldheorie: 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 Electromagnetiscs", Mcgraw-Hill (2013)	Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Cycle Content		
Content - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems Literature - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) - J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)		
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- Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems Literature - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) - J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)		- Boundary conditions
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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)		- Fields of electrical current density and specific methods of solving
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 - 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) 		- Numerical methods for solving time-independent problems
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- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) - J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)		- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
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		- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)		- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
		- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M0748: Materials in	Electrical Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Electrotechnical Experiments (L0714)		Lecture	1	1
Materials in Electrical Engineering (L0685)		Lecture	2	3
Materials in Electrical Engineering (Problem	m Solving Course) (L0687)	Recitation Section (small)	2	2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous	Highschool level physics and mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	Students can explain the composition and the structural properties o	f materials used in electrical engine	ering. Students can e	xplicate the relevance of
	mechanical, electrical, thermal, dielectric, magnetic and chemical prop	perties of materials in view of their ap	pplications in electrical	engineering.
Skills	Students can identify appropriate descriptive models and apply the		ve approximative solu	itions and judge factors
	influential on the performance of materials in electrical engineering ap	pplications.		
Personal Competence				
Social Competence	Students can jointly solve subject related problems in groups. They	can present their results effectivel	y within the frameworl	k of the problem solving
	course.			
Autonomy	Students are capable to extract relevant information from the provide			•
	reflect their acquired level of expertise with the help of lecture acco	mpanying measures such as exam	typical exam questio	ns. Students are able to
	connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation Elect	trical Engineering: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Electi	rical Engineering: Compulsory		



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



Course L0685: Materials in Electrica	al Engineering
Тур	
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	
	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator.
Content	Analysis of vibrations in a one-dimensional lattice.
	Phononic bandgap
	Introduction to quantum mechanics
	Wave function, Schrödinger's equation, observables and measurements.
	Quantum mechanical harmonic oscillator and spectral decomposition.
	Symmetries, conserved quantities, and the labeling of states.
	Angular momentum
	The hydrogen atom
	Waves in periodic potentials
	Reciprocal lattice and reciprocal lattice vectors
	Band gap
	Band diagrams
	The free electron gas and the density of states
	Fermi-Dirac distribution
	Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping.
	The P-N junction (diode)
	Light emitting diodes
	Electromagnetic waves interacting with materials
	Reflection and refraction
	Photonic band gaps
	Origins of magnetization
	Hysteresis in ferromagnetic materials
	Magnetic domains
Literature	Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials,
	Massachusetts Institute of Technology (MIT), 2013
	2.Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004
	3.Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994
	4.Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994
	5.Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979
	6.Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004
	7.Ashcroft, Mermin, Solid State Physics, Harcourt, 1976
	8.Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988
	9.Sze, Physics of Semiconductor Devices, Wiley, 1981
	10.Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007
	11. Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2008
	12.Handley, Modern Magnetic Materials, Wiley, 2000
	13.Wikipedia, Wikimedia
	10.thmpodia, thinhodia



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



Module M0672: Signals and	l Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0432)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(1.3.,		
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,	*	•	•
			<u> </u>	
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear	(,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I	•	in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sig	•	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and fre	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	·	ntrol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system	1.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation Computer Science: Core qualification: Compulsory	Biomedical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Civil- and Environmental Engangering: Co	ompuleony	
	General Engineering Science (English program): Specialisation		лпривогу	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsorv	
	General Engineering Science (English program): Specialisation		,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electi	ve Compulsory		



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

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



Mandala MOZOO, Electrical E	naine saine N/. Transmission Lines and December	vala Caminan		
Module MU/U9: Electrical E	ngineering IV: Transmission Lines and Resea	rcn Seminar		
Courses				
Title		Тур	Hrs/wk	СР
Research Seminar Electrical Engineering,	Computer Science, Mathematics (L0571)	Seminar	2	2
Transmission Line Theory (L0570)		Lecture	2	3
Transmission Line Theory (L0572)		Recitation Section (large)	2	1
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I-III, Mathematics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students can explain the fundamentals of wave propagation of	on transmission lines at low and high fr	equencies. They are abl	e to analyze circuits with
	transmission lines in time and frequency domain. They can de		nsmission lines. They are	able to solve problems
	with coupled transmission lines. They can present and discuss	a self-chosen research topic.		
Skills	Students can analyze and calculate the propagation of waves	in simple circuits with transmission line	es. They are able to ana	yze circuits in frequency
	domain and with the Smith chart. They can analyze equival	ent circuits of transmission lines. The	y are able to solve prob	lems including coupled
	transmission lines using the vectorial transmission line equation	ns. They are able to give a talk to profes	sionals.	
Personal Competence				
Social Competence	Students can analyze and solve problems in small groups an	d discuss their solutions. They can con	npare the learned theory	with experiments in the
	lecture and discuss it in small groups. They are able to present	a research topic to professionals and dis	scuss it with them.	
Autonomy	The students can solve problems by their own and are able to	acquire skills from the lecture and the	e literature. They are able	e to test their knowledge
	using computer animations. They can test their level of knowled	lge by answering short questions and te	sts during the lecture. Th	ey are able to relate their
	acquired knowledge to other lectures (e.g. Electrical Engineer	ing I-III and Mathematics I-III). They can	familiarize themselves v	vith a research topic and
	can prepare a presentation.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Specialisatio	n Electrical Engineering: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	n Electrical Engineering: Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			

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



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

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



Module M0734: Electrical E	Ingineering Project Laboratory		
Courses			
Title	Typ Hrs/wk CP		
Electrical Engineering Project Laboratory	(L0640) Laboratory Course 5 6		
Module Responsible	Prof. Christian Becker		
Admission Requirements	None		
Recommended Previous	Basic principles of electrical engineering		
Knowledge			
Educational Objectives			
Professional Competence			
Knowledge	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typica process of solving practical problems and present related results.		
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems. They identify 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 electric		
	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 develop alternative approaches to an electrical engineering problem independently or in groups and discuss advantages as well as drawbacks.		
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as extered 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 Lecture 70		
Credit points	6		
Examination	Project		
Examination duration and scale	based on task + presentation		
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory		
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory		
	Technomathematics: Core qualification: Elective Compulsory		

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



Module M0854: Mathematic	ne IV			
Module M0054. Mathematic	23 14			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Differential	l Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential	l Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential	I 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	Prof. Anusch Taraz		
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge				
		Mathematics IV. They are able to explain them using app		
		between these concepts. They are capable of illustrating	g these connections w	ith the help of examples.
	They know proof strategies and can repro	oduce them.		
Skills	Charles and see all see blooms in Mathematic		M	
		atics IV with the help of the concepts studied in this cour	se. Moreover, they are	e capable of solving then
	by applying established methods.			
	·	urther logical connections between the concepts studied		
	For a given problem, the students can de-	velop and execute a suitable approach, and are able to c	ritically evaluate the re	esults.
Personal Competence				
Social Competence				
		ns. They are capable to use mathematics as a common la		
		concepts according to the needs of their cooperating pa	rtners. Moreover, they	can design examples to
	check and deepen the understanding of t	heir peers.		
Autonomy	Students are capable of checking their up	nderstanding of complex concepts on their own. They o	an enecify onen gues	tions precisely and know
		inderstanding of complex concepts on their own. They c	an specify open ques	alons precisely and know
	where to get help in solving them.	ntance to be able to work for languar periods in a goal ario	ntad mannar an hard	nrahlama
	Students have developed sufficient persist	stence to be able to work for longer periods in a goal-orie	nted manner on nard	problems.
Workload in Hours	,	re 112		
Credit points				
Examination	Written exam	S. Francisco O		
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential	. ,		
Assignment for the Following): Specialisation Electrical Engineering: Compulsory		
Curricula): Specialisation Mechanical Engineering, Focus Mechatr		
): Specialisation Mechanical Engineering, Focus Theoret	icai Mechanical Engin	eering: Compulsory
	General Engineering Science (German program)			
	Computer Science: Specialisation Computationa	· ·		
	Electrical Engineering: Core qualification: Compr	,		
		: Specialisation Electrical Engineering: Compulsory		
	General Engineering Science (English program)	•		
	General Engineering Science (English program)	: Specialisation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
		Occupation of the Control of the Con	aal Maahaniaal Engin	
	General Engineering Science (English program)	: Specialisation Mechanical Engineering, Focus Theoretic	cai Mechanicai Engin	eering: Compulsory
		: Specialisation Mechanical Engineering, Focus Theoreti Ilisation Engineering Sciences: Elective Compulsory	cai Mechanicai Engin	eering: Compulsory
		Ilisation Engineering Sciences: Elective Compulsory	cai Mechanicai Engin	eering: Compulsory
	Computational Science and Engineering: Specia	ilisation Engineering Sciences: Elective Compulsory ical Mechanical Engineering: Compulsory	cai Mechanicai Engin	eering: Compulsory
	Computational Science and Engineering: Special Mechanical Engineering: Specialisation Theoretic	ilisation Engineering Sciences: Elective Compulsory ical Mechanical Engineering: Compulsory	cai Mechanicai Engin	eering: Compulsory
	Computational Science and Engineering: Special Mechanical Engineering: Specialisation Theoreti Mechanical Engineering: Specialisation Mechatr	alisation Engineering Sciences: Elective Compulsory ical Mechanical Engineering: Compulsory ronics: Compulsory	cai Medianicai Engin	eering: Compulsory



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	ecture	
Hrs/wk		
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations	
	Examples of partial differential equations	
	First order quasilinear differential equations	
	Normal forms of second order differential equations	
	Harmonic functions and maximum principle	
	Maximum principle for the heat equation	
	Wave equation	
	Liouville's formula	
	Special functions	
	Difference methods	
	Finite elements	
Literature	R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000	
	P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998	
	A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002	

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

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

Course L1038: Complex Functions			
Тур	Lecture		
Hrs/wk			
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	Main features of complex analysis		
	Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation		
Literature	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998 		



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

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



Module M0675: Introduction	n to Communications and Random Processes			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Communications and Rand	om Processes (L0442)	Lecture	3	4
Introduction to Communications and Rand	om Processes (L0443)	Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1-3 Signals and Systems Basic knowledge of probability theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual 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 be error rate and to decide for a suitable transmission method.			
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from approperiod by solving tutorial problems, software tools, clicker system.	•	ntrol their level of know	rledge during the lecture
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation I	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Spi	ecialisation Electrical Engineering: Com	npulsory	
	Computer Science: Specialisation Computer and Software Engine	eering: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation E			
	General Engineering Science (English program, 7 semester): Spe		pulsory	
	Computational Science and Engineering: Specialisation Enginee Technomathematics: Specialisation III. Engineering Science: Elec			
	Technomathematics: Specialisation III. Engineering Science: Electromathematics: Core qualification: Elective Compulsory	aive Compuisory		
	100/momationatios. Oure qualification. Liective Compulsory			



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

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



Module M0783: Measureme	ents: Methods and Data Processing			
Courses				
Title		Тур	Hrs/wk	СР
EE Experimental Lab (L0781)		Laboratory Course	2	2
Measurements: Methods and Data Proces	ssing (L0779)	Lecture	2	3
Measurements: Methods and Data Proces	ssing (L0780)	Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	none			
Recommended Previous	principles of mathematics			
Knowledge	principles of electrical engineering			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to explain the purpose of metrology and the acquisition and processing of measurements. They can detail aspects of probabilitheory and errors, and explain the processing of stochastic signals. Students know methods to digitalize and describe measured signals.			
Skills	The students are able to evaluate problems of metrol	ogy and to apply methods for describing and process	sing of measurements.	
Personal Competence Social Competence	The students solve problems in small groups.			
Autonomy	The students can reflect their knowledge and discuss	and evaluate their results.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Sp	ecialisation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 se		tive Compulsory	
Junicula	Computer Science: Specialisation Computer and Soi		compaioory	
	Electrical Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory			
			ve Compuisory	
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory			
	Technomathematics: Specialisation III. Engineering S			
	Technomathematics: Core qualification: Elective Cor	npuisory		

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

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



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



Module M0568: Theoretical	Electrical Engineering II: Time-Dependent	Fields		
Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering II: Time-	Dependent Fields (L0182)	Lecture	3	5
Theoretical Electrical Engineering II: Time-Dependent Fields (L0182) Theoretical Electrical Engineering II: Time-Dependent Fields (L0183)		Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I, Electrical Engineering II, Theoretic	al Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, Mathematics	0 0		
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence	<u> </u>	<u> </u>		
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subject related ta sessions).	sks in small groups. They are able to prese	ent their results effective	ely (e.g. during exercise
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 acquired knowledge and ongoing research at the Hamburg University of Technology (TUHH), e.g. in the area of high frequency engineering and optics.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following	General Engineering Science (German program): Specialis	sation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program, 7 semest		npulsory	
	Electrical Engineering: Core qualification: Compulsory		-	
	General Engineering Science (English program): Specialis	ation Electrical Engineering: Compulsory		
	General Engineering Science (English program, 7 semeste	er): Specialisation Electrical Engineering: Com	pulsory	
	Technomathematics: Specialisation III. Engineering Science	e: Elective Compulsory		
	Technomathematics: Core qualification: Elective Compulso	ory		



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



Course L0183: Theoretical Electrical Engineering II: Time-Dependent Fields				
Тур	Recitation Section (small)			
Hrs/wk	2			
СР	1			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
Lecturer	Prof. Christian Schuster			
Language	DE			
	/iSe			
Content	heory 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			
	olarization and superposition of planar waves			
	Reflection and refraction of planar waves at boundary surfaces			
	- Waveguide theory			
	- Rectangular waveguide, planar optical waveguide			
	- Elektrical and magnetical dipol radiation			
	- Simple arrays of antennas			
Literature	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)			
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)			
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)			
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)			
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)			
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)			



Module M0760: Electronic	Devices					
Courses						
itle	Ту	р	Hrs/wk	СР		
lectronic Devices (L0720)		cture	3	4		
lectronic Devices (L0721)	Pro	blem-based Learning	2	2		
Module Responsible	Prof. Hoc Khiem Trieu					
Admission Requirements	None					
Recommended Previous	Atomic model and quantum theory, electrical currents in solid state materials, b	asics in solid-state physics				
Knowledge	Successful participation of Physics for Engineers and Materials in Electrical Engineers	gineering or courses with equi	valent contents			
Educational Objectives	After taking part successfully, students have reached the following learning rest	ults				
Professional Competence						
Knowledge						
	Students are able					
	to represent the basics of semiconductor physics,					
	to explain the operating principle of important semiconductor devices,					
	to outline device characteristics and equivalent circuits as well as to exp	to outline device characteristics and equivalent circuits as well as to explain their derivation and				
	to discuss the limitation of device models.					
Skills						
SKIIIS						
	Students are capable					
	to apply devices in basic circuits,					
	to realize the physical context and to solve complex problems by onese	f				
Personal Competence						
Social Competence	Students are able to prepare and perform their lab experiments in team work as	s well as to present and discus	s the results in front	of audience		
coolai compotento	and all all all all all all all all all al	, won do to procent and diode		. 01 444.011001		
Autonomy	Students are capable to acquire knowledge based on literature in order to prep	are their experiments.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points	6					
Examination	Written exam					
Examination duration and scale	120 min					
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Eng					
Curricula	General Engineering Science (German program, 7 semester): Specialisation E	ectrical Engineering: Compuls	sory			
	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engi	neering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program)		sorv			
	Computational Science and Engineering: Specialisation Computer Science: El		,			



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

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



Module M0777: Semicondu	ctor Circuit Design				
Courses					
Title		Тур	Hrs/wk	СР	
Semiconductor Circuit Design (L0763)		Lecture	3	4	
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2	
Module Responsible	Prof. Wolfgang Krautschneider				
Admission Requirements	none				
Recommended Previous	Fundamentals of electrical engineering				
Knowledge	Basics of physics				
	basics of privates				
Educational Objectives	After taking part successfully, students have reached the	he following learning results			
Professional Competence					
Knowledge		different MOC devices in alcohomic signific			
	Students are able to explain the functionality of Students know the fundamental digital legis of	cuits and can discuss their advantages and disadva	antagos		
		circuits and can explain their functionality and spec			
	Students have solid knowledge about memory Students are able to explain how analog circuit		sincations.		
	Students know the appropriate fields for the use				
	cade included and appropriate include ion and ac-	o o supotar translations.			
Skills					
	· ·	erent MOS devices and can define the parameters	of electronic circuits.		
		cuits and can design different types of logic circuits.			
	Students can use MOS devices, operational an	nplifiers and bipolar transistors for specific applicati	ons.		
Personal Competence					
Social Competence	Students are able work efficiently in heterogen	eous teams.			
	Students are able work emicertally in neterogeneous learns. Students working together in small groups can solve problems and answer professional questions.				
Autonomy					
	Students are able to assess their level of knowledge.	ledge.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6			
Credit points	6	<u> </u>			
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following	General Engineering Science (German program): Spe	cialisation Electrical Engineering: Compulsory			
Curricula	General Engineering Science (German program): Spe		ronics: Compulsory		
	General Engineering Science (German program, 7 ser				
				oulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: 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): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory					
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engineering, Fo	cus Mechatronics: Comp	ulsory	
	Computational Science and Engineering: Specialisation	on Computer Science: Elective Compulsory			
	Mechanical Engineering: Specialisation Mechatronics: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Technomathematics: Core qualification: Elective Comp	pulsory			
	Technomathematics: Specialisation III. Engineering Sc	cience: Elective Compulsory			



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



Courses	
Title	Typ Hrs/wk CP
Introduction to Management (L0880)	Lecture 4 4 Problem-based Learning 2 2
Project Entrepreneurship (L0882) Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	basic Nilowiedge of Mathematics and Business
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from field of Management
	 explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and hum ressource management, information management, innovation management and marketing
	 explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately analyse 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	
	a work avacacifully in a team of students
	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	to communicate appropriately and
	to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	work in a team and to organize the team themselves
	to write a report on their project.
Workload in Hours	
Credit points	
Examination	
Examination duration and scale	
Assignment for the Following	
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation 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 Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Diophocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semissier): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulso General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering



Compulsory

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

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Тур	Lecture		
Hrs/wk	4		
CP	4		
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56		
Lecturer	maependent Study Time 64, Study Time in Lecture 36 Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgan		
Lecturer	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 		
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

Course L0882: Project Entrepreneurship			
Тур	Problem-based Learning		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Christoph Ihl		
Language	DE		
Cycle	WiSe/SoSe		
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.		
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.		



Specialization Computer Science

Module M0561: Discrete Al	gebraic Structures						
Courses							
Title		Тур	Hrs/wk	СР			
Discrete Algebraic Structures (L0164)		Lecture	2	3			
Discrete Algebraic Structures (L0165)		Recitation Section (small) 2 3					
Module Responsible	Prof. Karl-Heinz Zimmermann						
Admission Requirements	None.						
Recommended Previous	Mathematics from High School Diploma.						
Knowledge							
Educational Objectives	After taking part successfully, students have reached the following learning	g results					
Professional Competence							
Knowledge	The students know the important basics of discrete algebraic structures in	cluding elementary combinatorial stru	ctures, groups, rir	ngs, and vector spaces.			
	They also know specific structures like sub sum-, and quotient structures and homomorphisms.						
Chille							
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.						
4.4							
Autonomy	•						
	•						
	•						
	Students are able to acquire new knowledge from specific standard books and to associate this knowledge with other classes.						
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56						
Credit points	6						
Examination	Written exam						
Examination duration and scale	120 min						
Assignment for the Following	General Engineering Science (German program): Specialisation Compute	r Science and Engineering: Compulso	ory				
Curricula	Computer Science: Core qualification: Compulsory						
	General Engineering Science (English program): Specialisation Computer	Science and Engineering: Compulso	ry				
	Computational Science and Engineering: Core qualification: Compulsory						
	Technomathematics: Specialisation Mathematics: Elective Compulsory						

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

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



Module M0553: Objectorier	ted Programming, Algorithms and Data S	Structures		
Courses				
Title		Тур	Hrs/wk	СР
Objectoriented Programming, Algorithms a	and Data Structures (L0131)	Lecture	4	4
Objectoriented Programming, Algorithms a	and Data Structures (L0132)	Recitation Section (small)	1	2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended Previous	Mandatory prerequisite for this lecture is proficiency in	imperative programming (C, Pascal, Fortran or sin	milar). You should be	familiar with simple da
Knowledge	types (integer, double, char), arrays, if-then-else, for, whe programs and therefore should be proficient with editor objects and we will not repeat the basics mentioned about This remark is especially important for AIW, GES, LUM to those curricula in general. The programs ET, CI and IIW	r, compiler, linker and debugger. In this lecture wave. Decause those prerequisites are not part of the cu	e will immediately sta	erequisites for the start
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students can explain the essentials of software designatterns.	n and the design of a class architecture with re	ference to existing cl	ass libraries and design
	Students can describe fundamental data structures of dis	screte mathematics and assess the complexity of i	mportant algorithms fo	or sorting and searching
Skills	Students are able to Design software using given design patterns and Carry out software development and tests using Sort and search for data efficiently Assess the complexity of algorithms.			
Personal Competence Social Competence Autonomy	Students can work in teams and communicate in forums Students are able to solve programming tasks such as L of two to three weeks.		Google Test indeper	ndently and over a perio
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 Minutes, Content of Lecture, exercises and material in	n StudIP		
Assignment for the Following	General Engineering Science (German program): Specia	alisation Computer Science and Engineering: Cor	npulsory	
Curricula	Computer Science: Core qualification: Compulsory		· ·	
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specia	alisation Computer Science and Engineering: Com	pulsory	
	Computational Science and Engineering: Core qualifica	tion: Compulsory		
	Logistics and Mobility: Specialisation Engineering Scien	ce: Elective Compulsory		
	Technomathematics: Core qualification: Compulsory			



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

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



Title Logic, Automata Theory and Formal Languages (L0322) Rodule Responsible Prof. Tobias Knopp Port. Tobias Knowledge Afficiating students should be able to - specify algorithms for simple data structures (such as, e.g., arrays) to solve computational problems - apply propositional logic and predicate logic for specifying and understanding mathematical proofs - apply the knowledge and skills taught in the module Discrete Algebraic Structures Professional Competence Knowledge Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problem Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problem Students can explain unification and resolution for solving the predicate logic SAT decision problems are hard to represent with proposition logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalis automate and can identify relationships to logic and formal grammars. The spectrum that students can also describe syntax, semantics, and decision problems for malisms for which nondeterministic in a utomata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and the automata and can identify relationships to logic and formal grammars. The perticipants of the course can define various kinds of transform decision problems w.r.t. one formalisms in to decision problems w.r.t. other formalisms.	Module M0624: Logic, Auto	d Formal Languages			
Logic, Automata Theory and Formal Languages (L0332) Rectation Section (small) Prof. Tobias Knopp Admission Requirements Recommended Previous Knowledge Apricipating students should be able to - specify algorithms for simple data structures (such as, e.g., arrays) to solve computational problems - apply propositional logic and predicate logic for specifying and understanding mathematical proofs - apply the knowledge and skills taught in the module Discrete Algebraic Structures Educational Objectives Frofessional Competence Knowledge Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problems Students can explain syntax, semantics, and decision problems of define syntax, semantics, and decision problems for this representation formalisms. Students can explain unification and resolution for solving the predicate logic SAT decision problems for this representation formalisms submeasured by the students and can identify relationships to logic, and identify their application areas. The participants of the course can define various kinds of time automata and can identify relationships to logic, and identify their application areas. The participants of the course can define various kinds of time automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can problems wr.t. one formalisms into decision problems wr.t. other formalisms. They understand that some formalisms sayi yindia algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms as	Courses				
Module Responsible Prof. Tobias Knopp Admission Requirements None Recommended Previous Knowledge - specify algorithms for simple data structures (such as, e.g., arrays) to solve computational problems - apply propositional logic and predicate logic for specifying and understanding mathematical proofs - apply the knowledge and skills taught in the module Discrete Algebraic Structures Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problem Students can show correspondences to Boolean algebra. Students can describe which application problems are hard to represent with proposition logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalis Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, a decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of fire automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic an nondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is mexpressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students of transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily indical algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms so		2)			
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Students can apply propositional logic as well as predicate logic resolution to a given set of formulas. Students analyze application problems in order derive propositional logic, predicate logic, or temporal logic formulas to represent them. They can evaluate which formalism is best suited for a particular application problem, and they can demonstrate the application of algorithms for decision problems to specific formulas. Students can also transfer nondeterministic automata into deterministic ones, or derive grammars from automata and vice versa. They can show how parsers work, and they can apply algorithms for the language emptiness problem in case of infinite words.		an show correspondences to Boolean algebra. Stude therefore, the students can motivate predicate logic, an explain unification and resolution for solving the problems for various kinds of temporal logic, and identificand can identify relationships to logic and formal sinistic finite automata and pushdown automata to Ture than determinism. They are also able to demonstrate decision problems w.r.t. one formalism into decision problems w.r.t. one formalism into decision problems w.r.t. one formalism into decision problems are best suited for specifying systems automata, or grammars. an apply propositional logic as well as predicate logic positional logic, predicate logic, or temporal logic forminal problem, and they can demonstrate the application inistic automata into deterministic ones, or derive gra	ents can describe which application pround define syntax, semantics, and decised deciate logic SAT decision problem. Stuy their application areas. The participant grammars. The spectrum that studenting machines. Students can name those which decision problems require whore their properties. Students can describe which decision problems and their properties. Students can describe their properties. Students can describe their properties and their properties are to formulas. Students to represent them. They can evaluate of algorithms for decision problems to mmars from automata and vice versa. The state of the s	blems are hard to repision problems for this redents can also describs of the course can defis can explain ranges to formalism for which ich expressivity, and, is understand that some firibe the relationships but dents analyze applicate which formalism is b specific formulas. Studies.	resent with propositions epresentation formalism e syntax, semantics, and ine various kinds of finit from deterministic annondeterminism is morn addition, students calormalisms easily inductetween formalisms suction problems in order the est suited for a particula lents can also transform
Personal Competence	·				
Social Competence	· ·				
Autonomy Workload in Hours Independent Study Time 124, Study Time in Lecture 56		ant Study Time 124 Study Time in Lecture 55			
Credit points 6		ant Olday Time 124, Olday Time III Lecture 30			
Examination Written exam		am.			
		4111			
Examination duration and scale 90 min		princering Science (Cormon and and Constitution)	Computer Colones and Engineering Co	mpulaani	
Assignment for the Following General Engineering Science (German program): Specialisation Computer Science and Engineering: Compulsory Curricula Computer Science: Core qualification: Compulsory			Computer Science and Engineering: Co	IIIpuis0fy	
General Engineering Science (English program): Specialisation Computer Science and Engineering: Compulsory	Guiricula	· · ·	Computer Science and Engineering: Co	moulsory	
Computational Science and Engineering: Core qualification: Compulsory					
Technomathematics: Specialisation Informatics: Elective Compulsory	I		•		



Course L0332: Logic, Automata The	
	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Tobias Knopp
Language	EN
Cycle	SoSe
Content	Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF
	Propositional rogic, borreal algebra, propositional resolution, SAT-2NN Predicate logic, unification, predicate logic resolution
	3. Temporal Logics (LTL, CTL)
	Deterministic finite automata, definition and construction
	Regular languages, closure properties, word problem, string matching
	6. Nondeterministic automata:
	Rabin-Scott transformation of nondeterministic into deterministic automata
	7. Epsilon automata, minimization of automata,
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)
	8. Myhill-Nerode Theorem:
	Correctness of the minimization procedure, equivalence classes of strings induced by automata
	Pumping Lemma for regular languages:
	provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive enough to solve a word
	problem for some given language
	10. Regular expressions vs. finite automata:
	Equivalence of formalisms, systematic transformation of representations, reductions
	11. Pushdown automata and context-free grammars:
	Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping lemma for context-free
	grammars, transformation of formalisms (from pushdown automata to context-free grammars and back)
	12. Chomsky normal form
	13. CYK algorithm for deciding the word problem for context-free grammrs
	14. Deterministic pushdown automata
	15. Deterministic vs. nondeterministic pushdown automata:
	Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler
	16. Regular grammars
	17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars
	18. Chomsky hierarchy
	19. Mealy- and Moore automata:
	Automata with output (w/o accepting states), infinite state sequences, automata networks 20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verification w.r.t. temporal logic
	specifications (in particular LTL)
	21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic
	22. Fixed points, propositional mu-calculus
	23. Characterization of regular languages by monadic second-order logic (MSO)
Literature	Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.
	Logik für Informatiker Owe Schönlig, Spektrum, S. Adil. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006
	Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
	4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007
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Course L0507: Logic, Automata Theory and Formal Languages		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Tobias Knopp	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0672: Signals and	l Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0432)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(1.3.,		
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,	*	•	•
			<u> </u>	
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear	(,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I	•	in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sig	•	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and fre	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	·	ntrol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system	1.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation Computer Science: Core qualification: Compulsory	Biomedical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Civil- and Environmental Engangering: Co	ompuleony	
	General Engineering Science (English program): Specialisation		лпривогу	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsorv	
	General Engineering Science (English program): Specialisation		,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electi	ve Compulsory		



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

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



Courses				
litle little		Тур	Hrs/wk	СР
ntroduction to Management (L0880)		Lecture	4	4
Project Entrepreneurship (L0882)	Dut Obition Hill	Problem-based Learning	2	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	The latting part education, state in the following	.oagooa.to		
Knowledge	After taking this module, students know the important basics of m	iany different areas in Business and Ma	nagement, from Plan	ning and Organisation
· ·	Marketing and Innovation, and also to Investment and Controlling.		,	
	Formula in the difference in the latest and the second sec	and the state of t		and and all California Constant
	 explain the differences between Economics and Managen field of Management 	lent and the sub-disciplines in Manager	nent and to name impo	ortant definitions from ti
	explain the most important aspects of and goals in Manager	ement and name the most important asp	ects of entreprneurial r	oroiects
	describe and explain basic business functions as productions.			
	ressource management, information management, innova			. 9
	explain the relevance of planning and decision making i	n Business, esp. in situations under mi	ultiple objectives and	uncertainty, and expla
	some basic methods from mathematical Finance			
	state basics from accounting and costing and selected con	trolling methods.		
Ckillo	Studente are able to analyse business units with respect t	a different eritoria (organization obio	ativos atrotogios etc) and to corn, out ,
SKIIIS	Students are able to analyse business units with respect to Entrepreneurship project in a team. In particular, they are able to	onerent chiena (organization, objection)	clives, strategies etc	.) and to carry out a
	Emopreneuromp project in a team. In particular, and also to			
	analyse Management goals and structure them appropriate	əly		
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectiv			
	analyse production and procurement systems and Busines	s information systems		
	analyse and apply basic methods of marketing	to and 6 and architecture		
	select and apply basic methods from mathematical finance select and apply basic methods from the finance mathematical finance select and apply basic methods from the finance mathematical finance select and apply basic methods from the finance mathematical finance mathematica			
	apply basic methods from accounting, costing and controll	ng to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	work successfully in a team of students.			
	work successfully in a team of students to apply their knowledge from the lecture to an entroprened	urchin project and write a coherent repor	t on the project	
	to apply their knowledge from the lecture to an entreprener to communicate appropriately and	arsing project and write a conferent repor	t on the project	
	to confind find a phrophately and to cooperate respectfully with their fellow students.			
	to cooperate respectionly with their lenow 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 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation B	Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation (Computer Science and Engineering: Cor	npulsory	
	General Engineering Science (German program): Specialisation (Chemical Engineering: Compulsory		
	General Engineering Science (German program): Specialisation E	Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisation E	0,	, ,	
	General Engineering Science (German program): Specialisation (mpulsory	
	General Engineering Science (German program): Specialisation N			
	General Engineering Science (German program): Specialisation E			
	General Engineering Science (German program): Specialisation N			
	Civil- and Environmental Engineering: Core qualification: Compul	sory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory	uloon		
	Energy and Environmental Engineering: Core qualification: Comp		mpulaar:	
		ivii- ariu Eriviromentai Engeneering: Coi	inpulsory	
	General Engineering Science (English program): Specialisation C	ionrococc Engineering Committee		
	General Engineering Science (English program): Specialisation B			
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E	lectrical Engineering: Compulsory	ampulcos:	
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E	lectrical Engineering: Compulsory nergy and Enviromental Engineering: Co		
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation C	lectrical Engineering: Compulsory inergy and Enviromental Engineering: Co computer Science and Engineering: Com		
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation C General Engineering Science (English program): Specialisation M	lectrical Engineering: Compulsory inergy and Enviromental Engineering: Co computer Science and Engineering: Com dechanical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation C General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation B	lectrical Engineering: Compulsory nergy and Enviromental Engineering: Co computer Science and Engineering: Com lechanical Engineering: Compulsory iomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation C General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation N	lectrical Engineering: Compulsory nergy and Enviromental Engineering: Co computer Science and Engineering: Com lechanical Engineering: Compulsory iomedical Engineering: Compulsory laval Architecture: Compulsory		
	General Engineering Science (English program): Specialisation B General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation E General Engineering Science (English program): Specialisation C General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation B	lectrical Engineering: Compulsory nergy and Enviromental Engineering: Co computer Science and Engineering: Com lechanical Engineering: Compulsory iomedical Engineering: Compulsory laval Architecture: Compulsory		

Process 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

Course L0880: Introduction to Mana	agement
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,
	using their knowledge from the corresponding lecture.
	Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Module M0852: Graph Theo	ory and Optimization			
Courses				
Title		Тур	Hrs/wk	CP
Graph Theory and Optimization (L1046)		Lecture	2	3
Graph Theory and Optimization (L1047)	T	Recitation Section (small)	2	3
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Discrete Algebraic Structures			
Knowledge	Mathematics I			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence		g		
Knowledge				
	Students can name the basic concepts in Graph Theory a			•
	Students can discuss logical connections between these	concepts. They are capable of illustrating	ng these connections with	th the help of examples.
	They know proof strategies and can reproduce them.			
Skills	Students can model problems in Graph Theory and Optin	pization with the help of the concepts st	udied in this course. Mo	roover they are capable
	of solving them by applying established methods.	inzation with the help of the concepts sti	dalea III tilis course. Mo	reover, triey are capabi
	Students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are able to discover and verify further logical contains the students are also as a student and the students are also as a students are also as a student and the students are also as a students are also as a student and the students are also as a student and the students are also as a student and the students are also as a students are also as a student and the students are also as a student and a students are also as a student and	nnections between the concepts studied	in the course.	
	For a given problem, the students can develop and execu-	·		sults.
Personal Competence Social Competence	Students are able to work together in teams. They are cap In doing so, they can communicate new concepts according check and deepen the understanding of their peers.			can design examples i
Autonomy	Students are capable of checking their understanding of where to get help in solving them. Students have developed sufficient persistence to be able.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science and Engineering: Co	ompulsory	
Curricula	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation		mpulsory	
	Computational Science and Engineering: Core qualification: Cor			
	Logistics and Mobility: Specialisation Engineering Science: Elect			
	Technomathematics: Specialisation Mathematics: Elective Comp	uisuiy		



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

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



Module M0793: Seminars Computer Science and Mathematics				
Courses				
Title		Тур	Hrs/wk	CP
Seminar Computational Mathematics/Com	puter Science (L0797)	Seminar	2	2
Seminar Computational Engineering Scien	ce (L0796)	Seminar	2	2
Seminar Engineering Mathematics/Compu	ter Science (L1781)	Seminar	2	2
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Basic knowledge in Computer Science, Mathematics, and	d eventually Engineering Science.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students know who to acquire basic knowledge in a	rudimentary field of Computer Science, Mat	nematics, or Engineering So	cience.
Skills	The students are able to elaborate self-reliantly a rudimen	ntary subfield of Computer Science, Mathen	natics, or Engineering Scier	nce.
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Presentation			
Examination duration and scale	Pro Seminar erfolgt der Scheinerwerb durch Präsentation (Seminarvortrag 25 min und Diskussion 5 min)			
Assignment for the Following	General Engineering Science (German program): Specia	General Engineering Science (German program): Specialisation Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory			
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Special	isation Computer Science: Compulsory		
	General Engineering Science (English program, 7 semes	ster): Specialisation Computer Science: Con	npulsory	
	Computational Science and Engineering: Core qualification	on: Compulsory		

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

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



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



Module M0662: Numerical	Mathematics I			
Courses				
Title		Тур	Hrs/wk	CP
lumerical Mathematics I (L0417)		Lecture	2	3
lumerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Mathematik I + II for Engineering Students (german or en basic MATLAB knowledge 	iglish) or Analysis & Linear Algebra I + II for	Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration,	least squares problems, eigenvalue prob	lems, nonlinear root	finding problems and to
	explain their core ideas,			
	repeat convergence statements for the numerical method	ds,		
	 explain aspects for the practical execution of numerical r 	nethods with respect to computational and	storage complexitx.	
Skills	Students are able to			
	implement apply and compare numerical methods using	MATI AR		
	implement, apply and compare numerical methods using iustify the convergence behaviour of numerical methods.		aorithm	
	 justify the convergence behaviour of numerical methods select and execute a suitable solution approach for a giv 		gonum,	
	Select and execute a suitable solution approach for a give	en problem.		
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously composed teams (i.e.			edge), explain theoretica
	foundations and support each other with practical aspec	ts regarding the implementation of algorithr	ns.	
Autonomy	Students are capable			
	to assess whether the supporting theoretical and practical		or in a team,	
	 to assess their individual progess and, if necessary, to as 	sk questions and seek help.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisation		anics: Compulsory	
Carriodia	General Engineering Science (German program): Specialisation			nces: Compulsory
	General Engineering Science (German program): Specialisation		Ling.incoming color	.ooo. oompaloory
	General Engineering Science (German program, 7 semester): S		nrv	
	General Engineering Science (German program, 7 semester		•	Engineering Sciences
	Compulsory	,pa	,,	
	General Engineering Science (German program, 7 semester): S	pecialisation Biomedical Engineering: Con	npulsorv	
	General Engineering Science (German program, 7 semester): S			mpulsorv
	Bioprocess Engineering: Specialisation A - General Bioprocess			,
	Computer Science: Specialisation Computational Mathematics:			
	Electrical Engineering: Core qualification: Elective Compulsory			
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		nics: Compulsory	
	General Engineering Science (English program): Specialisation			ces: Compulsory
	General Engineering Science (English program, 7 semester): Sp			, ,
	General Engineering Science (English program, 7 semester		•	Engineering Sciences
	Compulsory			- 0
	General Engineering Science (English program, 7 semester): Sp	pecialisation Biomedical Engineering: Com	pulsory	
		* *		
	General Engineering Science (English program, 7 semester): Sp	bediansation Mechanical Engineering, Foct	is bioinechanics. Co	mpulsory
	General Engineering Science (English program, 7 semester): Sp Computational Science and Engineering: Core qualification: Co		is biomechanics. Co	mpulsory



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

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



Module M0834: Computern	etworks and Internet Security			
Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Internet Security	(L1098)	Lecture	3	5
Computer Networks and Internet Security	(L1099)	Recitation Section (small)	1	1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to explain important and common Internet p	protocols in detail and classify them, in order	r to be able to analyse	and develop networked
	systems in further studies and job.			
Skilla	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
Skills	Students are able to analyse common internet protocols and e	valuate the use of them in different domains	•	
Personal Competence				
Social Competence				
4.4	0. data	and a second control of the second control of the second control of	and and an developed to	
Autonomy	Students can select relevant parts out of high amount of profes	ssional knowledge and can independently le	arn and understand it	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Specialisati	on Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester):	Specialisation Computer Science: Elective 0	Compulsory	
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Elective Compulsor	у		
	General Engineering Science (English program): Specialisation	on Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester):	·	Compulsory	
	Computational Science and Engineering: Core qualification: 0			
	Technomathematics: Specialisation II. Informatics: Elective Co			
	Technomathematics: Specialisation II. Informatics: Elective Co	mpulsory		

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



Course L1099: Computer Networks and Internet Security	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0791: Computer A	Architecture			
Courses				
Title		Тур	Hrs/wk	СР
Computer Architecture (L0793)		Lecture	2	4
Computer Architecture (L0794)		Recitation Section (small)	2	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Module "Computer Engineering"			
Knowledge	The successful completion of the labs will be honored during the	e evaluation of the module's examination a	ccording to the followi	ng rules:
	Upon a passed module examination, the student is g	ranted a bonus on the examination's ma	rks due to the succes	ssful labs, such that the
	examination's marks are lifted by 0,3 or 0,4, respectively	, up to the next-better grade.		
	2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up	to 4,0 is not possible.		
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming			
	models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the			
	micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of			
	instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of			
	machine instructions and for memory hierarchies.			
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 similar problems alone or in a group	and to present the results accordingly.		
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and 4 lab attestations			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S	specialisation Computer Science: Elective	Compulsory	
	Computer Science: Specialisation Computer and Software Engi	neering: Elective Compulsory		
	General Engineering Science (English program): Specialisation	Computer Science: Compulsory		
	General Engineering Science (English program, 7 semester): S	pecialisation Computer Science: Elective (Compulsory	
	Computational Science and Engineering: Specialisation Compu	uter Science: Elective Compulsory		

Course L0793: Computer Architecture		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	 Introduction VHDL Basics Programming Models Realization of Elementary Data Types Dynamic Scheduling Branch Prediction Superscalar Machines Memory Hierarchies 	
Literature	 D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. 	



Course L0794: Computer Architecture	
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	see interlocking course
Literature	siehe korrespondierende Lehrveranstaltung
	see interlocking course



Module M0731: Functional I	Programming			
Courses				
Title		Тур	Hrs/wk	СР
Functional Programming (L0624)		Lecture	2	2
Functional Programming (L0625)		Recitation Section (large)	2	2
Functional Programming (L0626)		Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous	Discrete mathematics at high-school level			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
	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			
Skills	and total correctness. They distinguish laziness from other evaluation strategies. 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				
, and the second	Students practice peer programming with varying peers. They explain problems and solutions to their peer. They defend their programs orally. They communicate in English.			
Autonomy	In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") the mechanics of programming. In exercises, they develop solutions individually and independently, and receive feedback.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Computer Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): S	pecialisation 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): Sp	pecialisation Computer Science: Elective	Compulsory	
	Technomathematics: Specialisation II. Informatics: Elective Com	pulsory		

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



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

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



Module M0727: Stochastics	s			
Courses				
Title		Тур	Hrs/wk	CP
Stochastics (L0777)		Lecture	2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	none			
Recommended Previous	Calculus			
Knowledge	Discrete algebraic structures (combinatorics)			
	Propositional logic			
	1 Topodional Togro			
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	Students can explain the main definitions of probability, and they can	n give basic definitions of modeling	elements (rando	m variables, events,
	dependence, independence assumptions) used in discrete and continuous	us settings (joint and marginal distribu	utions, density fun-	ctions). 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, o	r estimators as the	ey 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. Studer	nts can also explain basic statistical de	tection and estima	tion techniques.
Skills	Is Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are good enough in various		d enough in various	
	application contexts, i.e., students can derive estimators and judge whether	r they are applicable or reliable.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Computer	Science: Compulsory		
Curricula	General Engineering Science (German program, 7 semester): Specialisation	on Computer Science: Compulsory		
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Computer	Science: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisatio	n Computer Science: Compulsory		
	Computational Science and Engineering: Core qualification: Compulsory			
	Logistics and Mobility: Specialisation Engineering Science: Elective Compa	ulsory		



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

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



Module M0971: Operating S	Systems			
Courses				
Title		Тур	Hrs/wk	СР
Operating Systems (L1153)		Lecture	2	3
Operating Systems (L1154)		Recitation Section (small)	2	3
Module Responsible	Prof. Volker Turau			
Admission Requirements	None			
Recommended Previous				
Knowledge	Object-oriented programming, algorithms, and data structures			
	Procedural programming Experience in using tools related to operating systems such as editions.	itare linkare compilare		
	Experience in using colibraries Experience in using C-libraries	itors, linkers, compilers		
	- Experience in using a natures			
Educational Objectives	After taking part successfully, students have reached the following learning	ig 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 sys	stems. They give examples of e	xisting operating sys	tems and explain their
	architectures. The participants of the course write concurrent programs us	sing threads, conditional variables	s and semaphores. St	udents 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 programm	ning in a correct and efficient was	v. They are able to i	udge the efficiency of a
	scheduling algorithm for a given scheduling task in a given environment.		,, a a ,	
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Compute			
Curricula	General Engineering Science (German program, 7 semester): Specialisat	tion Computer Science: Elective C	ompulsory	
	Computer Science: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Compute			
	General Engineering Science (English program, 7 semester): Specialisati	•	ompulsory	
	Computational Science and Engineering: Specialisation Computer Science	ce: Elective Compulsory		
	Technomathematics: Specialisation II. Informatics: Elective Compulsory			

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

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



Specialization Mechanical Engineering

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

Graduates have:

- 1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.
- 2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.
- 3) In-depth knowledge in Engineering applications, especially in the selected subject area of specialisation (product development and manufacturing, material science, aircrafts, energy Engineering, mechatronics, medical engineering, theoretical mechanical engineering). They have in particular the necessary methodological knowledge and its application to engineering problems, taking into account technical specifications and economic and social parameters.
- 4) The ability to work scientifically and to expand their specialized knowledge independently.

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

Module M0598: Mechanical	Engineering: Design			
Courses				
Title Embodiment Design and 3D-CAD (L0268) Mechanical Design Project I (L0695) Mechanical Design Project II (L0592) Table Project II (L0592)		Typ Lecture Practical Course Practical Course	Hrs/wk 2 3 3	CP 1 2 2
Team Project Design Methodology (L0267 Module Responsible	Prof. Dieter Krause	Problem-based Learning	2	ı
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Mechanical Engineering Design Mechanics Fundamentals of Materials Science Production Engineering			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence Knowledge	After passing the module, students are able to: explain design guidelines for machinery parts e.g. considered describe basics of 3D CAD, explain basics methods of engineering designing.	ing load situation, materials and manul	acturing requirements	,
Skills	After passing the module, students are able to: independently create sketches, technical drawings and doc design components based on design guidelines autonomo dimension (calculate) used components, use methods to design and solve engineering design tasks apply creativity techniques in teams.	usly,		
Personal Competence				
Social Competence Autonomy	After passing the module, students are able to: develop and evaluate solutions in groups including making moderate the use of scientific methods, present and discuss solutions and technical drawings withi reflect the own results in the work groups of the course. Students are able to estimate their level of knowledge using activating method. To solve engineering design tasks systematically.	n groups,	s),	
Workload in Hours	Independent Study Time 40, Study Time in Lecture 140			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specialisation E	nergy and Enviromental Engineering: 0	Compulsory	
Curricula	General Engineering Science (German program): Specialisation M General Engineering Science (German program): Specialisation B Energy and Environmental Engineering: Core qualification: Compu General Engineering Science (English program): Specialisation Er General Engineering Science (English program): Specialisation M General Engineering Science (English program): Specialisation Bi Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory	omedical Engineering: Compulsory ulsory nergy and Enviromental Engineering: Compulsory	ompulsory	
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			



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

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



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

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



Module M0933: Fundament	tals of Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Materials Science I (L10)	85)	Lecture	2	2
,	vanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on m	etals, ceramics and polymers a	and can describe this know	ledge comprehensively.
	Fundamental knowledge here means specifically the issues of a	tomic structure, microstructure, ph	ase diagrams, phase transf	ormations, corrosion and
	mechanical properties. The students know about the key aspect	cts of characterization methods fo	r materials and can identify	relevant approaches for
	characterizing specific properties. They are able to trace material	s phenomena back to the underlyi	ng physical and chemical lav	vs of nature.
OL III.		and the first of the section of the contract	Harris of matrix Matridals of	
Skills	The students are able to trace materials phenomena back to the			
	mechanical properties such as strength, ductility, and stiffness, c solidification, precipitation, or melting. The students can explain			
	can account for the impact of microstructure on the material's beh		conditions and the materials	microstructure, and trey
	can account for the impact of microstructure on the material's ben	avioi.		
Personal Competence				
Social Competence				
, ,				
Autonomy Workload in Hours	Independent Chidu Time Of Chidu Time in Lecture 94			
Credit points	Independent Study Time 96, Study Time in Lecture 84			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	Energy and Environmental Enginee	ring: Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		•	
	General Engineering Science (German program): Specialisation		- ,	
	Energy and Environmental Engineering: Core qualification: Com			
	General Engineering Science (English program): Specialisation I	•	ring: Compulsory	
	General Engineering Science (English program): Specialisation I	Mechanical Engineering: Compuls	ory	
	General Engineering Science (English program): Specialisation I	Biomedical Engineering: Compuls	ory	
	General Engineering Science (English program): Specialisation !	Naval Architecture: Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Elect	ve Compulsory		
	Mechanical Engineering: Core qualification: Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electiv	e Compulsory		

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



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

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



Module M0610: Electrical M	lachines			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous	Basics of mathematics, in particular complexe numbers, integrals,	differentials		
Knowledge	Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principles of electric a	nd magnetic fields.		
	They can describe the function of the standard types of electric ma	chines and present the corresponding	equations and charact	eristic curves.
Skills Personal Competence Social Competence Autonomy	Students arw able to calculate two-dimensional electric and magnethods of the design auf electric machines. They can calulate the operational performance of electric machine. They apply the usual equivalent circuits and graphical methods. none Students are able independently to calculate electric and magnerformance of electric machines from the characteristic data and	es from their given characteristic data a	nd selected quantities	and characteristic curve
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minuten			
Assignment for the Following	General Engineering Science (German program): Specialisation I	Energy and Enviromental Engineering:	Compulsory	
Curricula	General Engineering Science (German program): Specialisation !	Mechanical Engineering: Elective Comp	oulsory	
	Electrical Engineering: Core qualification: Elective Compulsory			
	Energy and Environmental Engineering: Core qualification: Comp	ulsory		
	General Engineering Science (English program): Specialisation E	nergy and Enviromental Engineering:	Compulsory	
	General Engineering Science (English program): Specialisation N	lechanical Engineering: Elective Comp	ulsory	
	Computational Science and Engineering: Specialisation Engineer	ing Sciences: Elective Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Electi	ve Compulsory		
	Mechanical Engineering: Core qualification: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory			



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

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



Module M0865: Fundament	als of Production and Quality Mana	agement			
Courses					
Title		Тур	Hrs/wk	CP	
Production Process Organization (L0925)		Lecture	2	3	
Quality Management (L0926)		Lecture	2	3	
Module Responsible	Prof. Hermann Lödding				
Admission Requirements	none				
Recommended Previous	Fundamentals of Production and Quality Manag	gement			
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ached the following learning results			
Professional Competence					
Knowledge	Students are able to explain the contents of the	lecture of the module.			
Skills	Students are able to apply the methods and mo	dels in the module to industrial problems.			
Personal Competence					
Social Competence	-				
Autonomy	-				
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	180 Minuten				
Assignment for the Following	General Engineering Science (German program	m): Specialisation Mechanical Engineering: Elective Co	ompulsory		
Curricula	General Engineering Science (English program	n): Specialisation Mechanical Engineering: Elective Co	mpulsory		
	International Production Management: Technic	al Complementary Course Core Studies: Elective Com	pulsory		
	Logistics and Mobility: Specialisation Engineeri	ing Science: Elective Compulsory			
	Mechanical Engineering: Core qualification: Ele	ective Compulsory			

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

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



Module M0672: Signals and	l Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0432)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch	(1.3.,		
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,	*	•	•
			<u> </u>	
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear	(,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I	•	in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sig	•	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and fre	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	·	ntrol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system	1.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation Computer Science: Core qualification: Compulsory	Biomedical Engineering: Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	Civil- and Environmental Engangering: Co	ompuleony	
	General Engineering Science (English program): Specialisation		лпривогу	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		mpulsorv	
	General Engineering Science (English program): Specialisation		,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation Engineering Science: Electi	ve Compulsory		



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

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



Module M0680: Fluid Dynar	mics			
Courses				
Title		Tun	Hrs/wk	CP
		Тур	7 nrs/wk	5
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Lecture Recitation Section (large)	3 1	1
Module Responsible	Prof. Heinz Herwig	riecitation dection (large)	1	1
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II			
Knowledge	recimical memodynamics i, ii			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence	The taking part succession, succents have reached the following to	arming results		
Knowledge	The students are able to			
Niewiedge	The stadents are able to			
	- distinguish the different physical mechanism of fluid dynamics,			
	- understand the different mathematic modeling of fluid flow,			
	- to apply and calculate fluid flow processes in different problems in	nature and techniques.		
Skills	The students are able to			
	- understand the physics of Fluid Dynamics,			
	- calculate and evaluate complex Fluid Dynamics processes,			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an app	oroach.		
Autonomy	The students are able to develop a complex problem self-consistent	and analyse the results in a critical wa	ay. A qualified exchan	ge with other students is
	given.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Me	chanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Bio	medical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Med			
	General Engineering Science (English program): Specialisation Bior			
	Computational Science and Engineering: Specialisation Engineering			
	Mechanical Engineering: Core qualification: Compulsory	. ,		
	Technomathematics: Specialisation Engineering Science: Elective C	Compulsory		
	, . , . , ,	• •		

Course L0454: Fluid Mechanics		
Тур	cture	
Hrs/wk	3	
CP	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Heinz Herwig	
Language	DE	
Cycle	SoSe	
Content	Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows	
Literature	 Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 	



Course L0455: Fluid Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heinz Herwig
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0934: Advanced	Materials			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Materials Characterization (L10	187)	Lecture	2	2
Advanced Materials Design (L1091)	,	Lecture	2	2
Advanced Materials Design (L1092)		Recitation Section (large)	2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	none			
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of ad-	vanced materials along with their applications	s in technology, in pa	rticular metallic, ceramic,
	polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
0.11				
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.	•	idern materials scienc	e, which enables them to
	select optimum materials combinations depending on the t	echnical applications.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists an	d to develop ideas further.		
Autonomy	The students are able to			
,				
	 assess their own strengths and weaknesses. 			
	 define tasks independently. 			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialis	sation Mechanical Engineering: Elective Comp	ulsory	
Curricula	General Engineering Science (English program): Specialis	ation Mechanical Engineering: Elective Compu	ulsory	
	Mechanical Engineering: Core qualification: Elective Comp	pulsory		

Course L1087: Advanced Materials Characterization		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Patrick Huber	
Language	DE	
Cycle	SoSe	
Content	1. Porous Solids - Preparation, Characterization and Functionalities	
	2. Fluidics with nanoporous membranes	
	3. X-ray diffraction for microstructure analysis	
	4. Thermoplastic elastomers	
	5. Optimization of polymer properties by nanoparticles	
	6. Fiber composites in automotive	
	7. Modeling of materials based on quantum mechanics	
	8. Mechanical properties of biomaterials	
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).	
	William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).	



Course L1091: Advanced Materials	Design
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marlis Bussacker, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE/EN
Cycle	SoSe
Content	Aluminiumlegierungen im Flugzeugbau:
	Korrosionsbeständige Varianten, Legierungen mit niedriger Dichte und hoher Steifigkeit; Ermüdungseigenschaften unter einsatznahen
	Belastungsbedingungen
	Titanlegierungen im Flugzeugbau:
	Hochtemperaturlegierungen für Flugtriebwerke (Kompressor):
	Optimierung von Kriech- und Schwingfestigkeit;
	höchstfeste Legierungen für Flugzeugstrukturbauteile:
	Optimierung von Streckgrenze und Bruchzähigkeit
	Demonstrationsversuche an Aluminium- und Titanlegierungen im Labor
	Metall-Keramik-Verbundwerkstoffe:
	spezifische Vor- und Nachteile
	Herstellung von Funktionskeramiken:
	Multilayer-Keramik für Aktoren in der Mikropositionierungstechnik am Beispiel der PZT-Keramik
	mechanische und elektrische Zuverlässigkeit von Funktionskeramiken
	neue Entwicklungen bei den Polymerlegierungen:
	z.B. thermoplastische Elastomere
	Polymer/Polymer-Verbundwerkstoffe:
	z.B. PE-Faser verstärktes PE
	biologisch abbaubare Polymere und polymere Verbundwerkstoffe:
	z.B. Flachsfasern in Polycaprolakton
	Aufbau und Eigenschaften intermetallischer Aluminide (auf Basis Fe, Ni, Ti)
	Herstellung und Anwendungen von intermetallischen Legierungen
	Phasen- und Gefügeanalyse eines Verbundwerkstoffes auf Basis intermetallischer Phasen (mit Laborübung)
Literature	Vorlesungsunterlagen

Course L1092: Advanced Materials Design	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marlis Bussacker, 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



Courses				
Title		Тур	Hrs/wk	СР
Mechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1137)	Lecture	3	3
Mechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1138)	Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillations, An	alytical Mechanics, Multibody Systems) (L1139)	Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried			
Admission Requirements	none			
Recommended Previous	Mechanics I (Statics) and Mechanics III (Hydrostatics, Kine	ematics, Dynamics)		
Knowledge	Mathematics I and II			
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	The students can			
	describe the axiomatic procedure used in mechani	ical contexts;		
	explain important steps in model design;			
	present technical knowledge.			
Skills	The students can			
	explain the important elements of mathematical / m	nechanical analysis and model formation, and ac	only 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 probl	em sets.	
Personal Competence				
Social Competence	The students can work in groups and support each other to	o overcome difficulties		
Gooda Competence	The stadents dan workin groups and support each other to	o vercome announces.		
Autonomy	Students are capable of determining their own strengths a	nd weaknesses and to organize their time and le	earning based on thos	se.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Speciali	isation Mechanical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Speciali			
Jailloula	General Engineering Science (German program): Speciali			
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis	sation Biomedical Engineering: Compulsory		
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis Mechanical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis Mechanical Engineering: Core qualification: Compulsory	sation Naval Architecture: Compulsory		

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



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

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



Module M0956: Measureme	ent Technology for Mechanical and Process E	Engineers			
Courses					
Title		Тур	Hrs/wk	СР	
Practical Course: Measurement and Control Systems (L1119)		Laboratory Course	2	2	
Measurement Technology for Mechanical	and Process Engineers (L1116)	Lecture	2	3	
Measurement Technology for Mechanical	and Process Engineers (L1118)	Recitation Section (large)	1	1	
Module Responsible	Dr. Sven Krause				
Admission Requirements	none				
Recommended Previous	Basic knowledge of physics, chemistry and electrical enginee	ring			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results			
Professional Competence					
Knowledge	Students are able to name the most important fundmentals of	of the Measurement Technology (Quantities	and Units, Uncertainty	, Calibration, Static ar	
	Dynamic Properties of Sensors and Systems).				
	They can outline the most important measuring methods for o	different kinds of quantities to be maesured (Electrical Quantities.	Temperature, mechanic	
	quantities, Flow, Time, Frequency).				
	They can describe important methods of chemical Analysis (G	Gas Sensors, Spectroscopy, Gas Chromatogr	aphy)		
Skills	Students can select suitable measuring methods to given pro-	blems and can use refering measurement de	vices in practice.		
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues in				
	the right context and application area.	area of measurement technology and solution	лі арріоаспез аз жеі	i as piace the issues in	
	are ngm comon and approximation area.				
Personal Competence					
Social Competence	Students can arrive at work results in groups and document the	nem in a common report.			
Autonomy	Students are able to familiarize themselves with new measure	ement technologies.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	105 minutes				
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Energy and Environmental Engineering: (Compulsory		
Curricula	General Engineering Science (German program): Specialisate General Engineering Science (German program): Specialisate		ompulsory		
Garriodia	General Engineering Science (German program): Specialisat				
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Medianical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester)				
	Energy and Environmental Engineering: Core qualification: Compulsory				
	General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Compu	ilsory		
	Mechanical Engineering: Core qualification: Compulsory				
	Mechatronics: Core qualification: Compulsory				
	Process Engineering: Core qualification: Compulsory				



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



Course L1116: Measurement Techr	nology for Mechanical and Process Engineers
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Language	DE
Cycle	
00.110.11	
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front of the class.
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

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



odule M0829: Foundation	ns of Management		
ourses	Typ Hrs/w	vk C	D
roduction to Management (L0880)	Typ Hrs/w Lecture 4	vk Ci	r
oject Entrepreneurship (L0882)	Problem-based Learning 2	2	
Module Responsible	Prof. Christoph Ihl		
Admission Requirements	s None		
Recommended Previous	Basic Knowledge of Mathematics and Business		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, fro Marketing and Innovation, and also to Investment and Controlling. In particular they are able to	m Planning and	d Organisation
		:	- fi - i ki f k
	 explain the differences between Economics and Management and the sub-disciplines in Management and to natifield of Management 	me important de	etinitions from t
	explain the most important aspects of and goals in Management and name the most important aspects of entrepring the en	neurial projects	
	describe and explain basic business functions as production, procurement and sourcing, supply chain manager.		
	ressource management, information management, innovation management and marketing	, . 3	
	explain the relevance of planning and decision making in Business, esp. in situations under multiple objective	es and uncerta	inty, and expl
	some basic methods from mathematical Finance		
	state basics from accounting and costing and selected controlling methods.		
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strateg Entrepreneurship project in a team. In particular, they are able to	ies etc.) and	to carry out
	and a Marian and a design to the second state of the second state		
	analyse Management goals and structure them appropriately analyse organisational and staff structures of companies		
	analyse organisational and stall 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 legture to an entrangeneurable project and write a coherent report on the project.	.+	
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the projec to communicate appropriately and 	il	
	to cooperate respectfully with their fellow students.		
	,,		
Autonomy	y Students are able to		
	work in a team and to organize the team themselves		
	to write a report on their project.		
Workload in House	a Jadanandani Study Tima OS Study Tima in Lastyca 94		
Workload in Hours			
Credit points			
Examination Examination duration and scale			
Assignment for the Following Curricula			
Carriodia	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 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: Cor	mpulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron		у
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan	nics: Compulso	ry
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys	stems Engineer	ing: Compulso
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mate	erials in Engine	eering Science
	Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theor	retical Mechani	ical Engineerii



Compulsory

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

ompulsory

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

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

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

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



ourse L0880: Introduction to Mana	gement
Тур	Lecture
Hrs/wk	4
СР	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang
	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Course L0882: Project Entrepreneu	rship
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept,
	using their knowledge from the corresponding lecture.
	Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Focus Biomechanics

The specialization Biomechanics in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Riomechanics an economical oriented master study

	dical Basics I				
ourses					
tle		Тур	Hrs/wk	CP	
troduction to Anatomy (L0384) troduction to Radiology and Radiation T	herapy (I 0383)	Lecture Lecture	2	3	
Module Responsible		Lecture	2	3	
Admission Requirements					
Recommended Previous					
Knowledge Educational Objectives		and the following learning results			
Professional Competence	, ,	led the following realiting results	_		
Knowledge	Therapy				
	The students can distinguish different types of cur	rently used equipment with respect to its use in rac	diation therapy.		
	The students can explain complex treatment plans	s used in radiation therapy in interdisciplinary cont	exts (e.g. surgery, internal m	nedicine).	
	The students can describe the patients' passage f	rom their initial admittance through to follow-up ca	re.		
	Diagnostics				
	The students can illustrate the technical base of imaging techniques (CT, MRT, US).	concepts of projection radiography, including ang	giography and mammograp	ohy, as well as section	
	The students can explain the diagnostic as well as	s therapeutic use of imaging techniques, as well as	s the technical basis for thos	e techniques.	
	The students can choose the right treatment meth	od depending on the patient's clinical history and r	needs.		
	The student can explain the influence of technical	errors on the imaging techniques.			
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.				
	Anatomy				
	The students can describe				
	basal structures and functions of internal organs and the musculoskeletal system				
	The students can describe the basic macroscopy	and microscopy of those systems.			
Skills	Therapy				
	The students can distinguish curative and palliative situations and motivate why they came to that conclusion.				
	The students can develop adequate therapy conc	epts and relate it to the radiation biological aspect	S.		
	The students can use the therapeutic principle (ef				
		adiation, can choose the best one depending on	the situation (location of the	e tumor) and choose	
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups social services, psycho-oncology).				
	Diagnostics				
	The students can suggest solutions for repairs of imaging instrumentation after having done error analyses.				
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge of anatomy, pathology a pathophysiology.				
	Anatomy				
	The students can recognize the relationship betw of structures and their functions in the context of w	een given anatomical facts and the development idespread diseases.	of common diseases; they c	an explain the releva	
Personal Competence Social Competence		on of tumor patients and interact with them in a pro	ofessional way.		
	The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeutic measures and can meet the appropriately.				
		s in biomedical research and medicine on a profes	ssional level.		
Autonomy	·	·			
Autonomy					
Autonomy	The students can introduce younger students to the	ne clinical daily routine.			



	relevant knowledge themselves.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	90 Minuten, many questions
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Technomathematics: Specialisation Engineering Science: Elective Compulsory

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



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



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

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



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



ourses				
tle		Тур	Hrs/wk	CP
imerical Mathematics I (L0417)		Lecture	2	3
Imerical Mathematics I (L0418)	Duef Cabina La Barra	Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements Recommended Previous	None			
Knowledge	Mathematik I + II for Engineering Students (german or er basic MATLAB knowledge	nglish) or Analysis & Linear Algebra I + II for	Technomathematic	ians
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration, explain their core ideas, repeat convergence statements for the numerical methode explain aspects for the practical execution of numerical resources.	ds,		t finding problems and
Skills	Students are able to			
		MATI AD		
	implement, apply and compare numerical methods using institutes convergence behaviour of numerical methods		a a rith m	
	 justify the convergence behaviour of numerical methods select and execute a suitable solution approach for a given 		gonunn,	
	- Solodi and execute a suitable solution approach for a give	on problem.		
Personal Competence				
Social Competence	Students are able to			
	work together in heterogeneously composed teams (i.e.)	teams from different study programs and	d background knowle	edge), explain theoret
	foundations and support each other with practical aspec			0 // 1
Autonomy	Students are capable			
	to assess whether the supporting theoretical and practical.	al excercises are better solved individually	or in a team,	
	to assess their individual progess and, if necessary, to as			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		in Engineering Scie	nces: Compulsory
	General Engineering Science (German program): Specialisation	0 0 1 ,		
	General Engineering Science (German program, 7 semester): S		-	n Engineering Science
			j, i ocus ivialellais i	ii Liigiileeiilig Scielic
	General Engineering Science (German program, 7 semester	r): Specialisation Mechanical Engineering		
	Compulsory		npulsorv	
		specialisation Biomedical Engineering: Con		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc Engineering: Elective Compulsory		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc Engineering: Elective Compulsory		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics:	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory		ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation	specialisation Biomedical Engineering: Con specialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory	us Biomechanics: C	ompulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation	specialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha	us Biomechanics: Co	
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha	us Biomechanics: Control of the cont	nces: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester)	pecialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha	us Biomechanics: Control of the cont	nces: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester) Compulsory	pecialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha Mechanical Engineering, Focus Materials pecialisation Computer Science: Compulsor): Specialisation Mechanical Engineering	us Biomechanics: Constitution of the state o	nces: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester) Compulsory General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha Mechanical Engineering, Focus Materials pecialisation Computer Science: Compulsor): Specialisation Mechanical Engineering pecialisation Biomedical Engineering: Compulsory	us Biomechanics: Compulsory in Engineering Scientry in Focus Materials in	nces: Compulsory n Engineering Science
	Compulsory General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Bioprocess Engineering: Specialisation A - General Bioprocess Computer Science: Specialisation Computational Mathematics: Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester) Compulsory	pecialisation Biomedical Engineering: Conspecialisation Mechanical Engineering, Foc Engineering: Elective Compulsory Elective Compulsory Computer Science: Compulsory Biomedical Engineering: Compulsory Mechanical Engineering, Focus Biomecha Mechanical Engineering, Focus Materials pecialisation Computer Science: Compulsor): Specialisation Mechanical Engineering pecialisation Biomedical Engineering: Compecialisation Mechanical Engineering, Focus	us Biomechanics: Compulsory in Engineering Scientry in Focus Materials in	nces: Compulsory n Engineering Science



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

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



. Andreas Moschaliski	Typ Lecture	Hrs/wk	
. Andreas Moschaliski		Hrs/wk	
. Andreas Moschallski		Hrs/wk	
. Andreas Moschallski			CP
. Andreas Moschallski		3	5
. Andreas Moschallski	Recitation Section (large)	2	1
ne			
chnical Thermodynamics I, II and Fluid Dynamics			
er taking part successfully, students have reached the follow	ing learning results		
e students are able to			
escribe the different physical mechanism of Heat Transfer,			
xplain the technical terms,			
o analyse comlex heat transfer processes in a critical way.			
e students are able to			
nderstand the physics of Heat Transfer,			
alculate and evaluate complex Heat Transfer processes,			
olve excersises self-consistent and in small groups.			
e students are able to discuss in small groups and develop a	an approach.		
e students are able to develop a complex problem self-cons	istent and analyse the results in a critical way	v. A qualified exchan	ge with other students is
ven.		, 4	g
dependent Study Time 110, Study Time in Lecture 70			
0 min			
eneral Engineering Science (German program): Specialisation	on Mechanical Engineering, Focus Biomecha	nics: Compulsory	
		stems: Compulsory	
	r): Specialisation Mechanical Engineering,	Focus Theoretical N	lechanical Engineering:
•	Specialization Biomedical Engineering Com	ouloon.	
		puisui y	
		nics: Compulsory	
	* **		
			ering: Compulsorv
ompulsory			39.
·	Specialisation Biomedical Engineering: Comp	oulsory	
echanical Engineering: Specialisation Theoretical Mechanica	al Engineering: Compulsory		
	chnical Thermodynamics I, II and Fluid Dynamics er taking part successfully, students have reached the follow e students are able to escribe the different physical mechanism of Heat Transfer, xplain the technical terms, analyse comlex heat transfer processes in a critical way. e students are able to nderstand the physics of Heat Transfer, alculate and evaluate complex Heat Transfer processes, olive excersises self-consistent and in small groups. e students are able to discuss in small groups and develop a e students are able to develop a complex problem self-consider. dependent Study Time 110, Study Time in Lecture 70 ditten exam 0 min eneral Engineering Science (German program): Specialisation eneral Engineering Science (German program, 7 semester): eneral Engineering Science (German program, 7 semester): eneral Engineering Science (English program, 7 semester): eneral	er taking part successfully, students have reached the following learning results e students are able to escribe the different physical mechanism of Heat Transfer, xplain the technical terms, p analyse comlex heat transfer processes in a critical way. e students are able to inderstand the physics of Heat Transfer, alculate and evaluate complex Heat Transfer processes, olive excersises self-consistent and in small groups. e students are able to discuss in small groups. e students are able to develop a complex problem self-consistent and analyse the results in a critical way ren. dependent Study Time 110, Study Time in Lecture 70 fitten exam 0 min meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Sy meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretica meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretica meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretica meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus meral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering, Focus meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Sy meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Sy meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Sy meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Sy meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretica meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretica meral Engineering Science (English program): Specialisation Mechanical E	chanical Thermodynamics I, II and Fluid Dynamics are taking part successfully, students have reached the following learning results as students are able to ascribe the different physical mechanism of Heat Transfer, xplain the technical terms, analyse comiex heat transfer processes in a critical way. a students are able to aderstand the physics of Heat Transfer, alculate and evaluate complex Heat Transfer processes, alculates are able to discuss in small groups. a students are able to discuss in small groups and develop an approach. a students are able to develop a complex problem self-consistent and analyse the results in a critical way. A qualified exchangen. Appendent Study Time 110, Study Time in Lecture 70 ditten exam O min meral Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory meral Engineering Science (German program): Specialisation Biomedical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mempulsory meral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering; Compulsory meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory meral Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanical Engineering Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomec

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014
	- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



Course L0459: Heat Transfer	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1279: MED II: Intro	oduction to Biochemistry and Molec	ular Biology		
Courses				
Title		Тур	Hrs/wk	CP
Introduction to Biochemistry and Molecular	Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge				
	The students can			
	 describe basic biomolecules; 			
	 explain how genetic information is coded in 	in the DNA:		
	explain the connection between DNA and			
	•	•		
Skills				
	The students can			
	recognize the importance of molecular par	rameters for the course of a disease;		
	describe different molecular-diagnostic tre	atments;		
	describe the importance of those treatments for so	ome diseases;		
Personal Competence				
Social Competence				
	The students can conduct discussions in research	and medicine on a technical level.		
Autonomy	The students can develop understanding of topics	s from the course, using technical literature, by them	iselves	
Workload in Hours	Independent Study Time 62, Study Time in Lectur	e 28		
Credit points	3			
Examination	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following		: Specialisation Mechanical Engineering, Focus Bio	mechanics: Compulsorv	
Curricula		Specialisation Biomedical Engineering: Compulso		
		7 semester): Specialisation Biomedical Engineering		
		7 semester): Specialisation Mechanical Engineering		pulsory
	Electrical Engineering: Specialisation Medical Te	chnology: Elective Compulsory		
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Bior	mechanics: Compulsory	
	General Engineering Science (English program):	Specialisation Biomedical Engineering: Compulsor	у	
	General Engineering Science (English program, 7	7 semester): Specialisation Mechanical Engineering	g, Focus Biomechanics: Com	pulsory
		7 semester): Specialisation Biomedical Engineering	: Compulsory	
	Mechanical Engineering: Specialisation Biomech			
	0 0 1	nent and Business Administration: Elective Compuls	,	
		Organs and Regenerative Medicine: Elective Compr		
		Fechnology and Control Theory: Elective Compulso	ry	
	Biomedical Engineering: Specialisation Implants	' ' '		
	Technomathematics: Core qualification: Elective (• •		
	Technomathematics: Specialisation III. Engineering	ig ocience. Liective Compulsory		

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



Module M1280: MED II: Intro	oduction to Physiology			
Courses				
Title	Тур		Hrs/wk 2	CP
Introduction to Physiology (L0385)	Lecture		2	3
Module Responsible				
Admission Requirements				
Recommended Previous	None			
Knowledge	After the Community of the state of the community of the			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
	The students can			
	describe the basics of the energy metabolism;	and a construction		
	describe physiological connections in select fields of muscle, heart/circulation, neuro	- and sensory physiolo	gy.	
Skills				
	The students can			
		-f:-f		d:
	describe the effects of basic bodily functions (sensory, transmission and processing or relate them to similar technical proteins.)	of information, develop	ment of forces an	d vital functions) and
	relate them to similar technical systems.			
Personal Competence				
Social Competence				
	The students can conduct discussions in research and medicine on a technical level.			
	The students can find colutions to problems in the field of physiclemy, both analytical and ma	tralagical		
	The students can find solutions to problems in the field of physiology, both analytical and me	liological		
Autonomy	The students can develop understanding of topics from the course, using technical literature,	, by themselves		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points				
Examination	Written exam			
Examination duration and scale	60 minutes			
		agus Biomaghanias C	ampulaan.	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, F General Engineering Science (German program): Specialisation Biomedical Engineering: C		ompuisory	
Sarricula	General Engineering Science (German program). Specialisation Biomedical Engineering. C			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Science (German program pr			ılsorv
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory	530g, . 0000 DIOIII		,
	General Engineering Science (English program): Specialisation Mechanical Engineering, Fo	ocus Biomechanics: Co	mpulsorv	
	General Engineering Science (English program): Specialisation Biomedical Engineering: Co		e	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering		echanics: Compu	Isory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Eng	-	, ,	-
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Co	ompulsory		
	Biomedical Engineering: Specialisation Management and Business Administration: Elective	Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective	re 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
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Roger Zimmermann
Language	DE
Cycle	SoSe
Content	
Literature	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme
	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier



Focus Energy Systems

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

Module M0597: Advanced	Mechanical Engineering Design				
	3 3 3				
Courses					
Title		Тур	Hrs/wk	CP	
Advanced Mechanical Engineering Design II (L0264)		Lecture	2	2	
Advanced Mechanical Engineering Design II (L0265)		Recitation Section (large) Lecture	2	1 2	
Advanced Mechanical Engineering Design I (L0262) Advanced Mechanical Engineering Design I (L0263)		Recitation Section (large)	2	1	
Module Responsible	Prof. Dieter Krause	rissidation session (ial ge)			
Admission Requirements	None				
Recommended Previous	Notice				
Knowledge	 Fundamentals of Mechanical Engineering Desig 	n			
Knowledge	Mechanics				
	 Fundamentals of Materials Science 				
	 Production Engineering 				
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence					
Knowledge	After passing the module, students are able to:				
	explain complex working principles and functions	s of machine elements and of basic elements of fl	uidics.		
	explain requirements, selection criteria, applicati				
	indicate the background of dimensioning calcula		,		
	3				
Skills	After passing the module, students are able to:				
	accomplish dimensioning calculations of covered	d 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 technical informatio	n in the lecture supported by activating methods.			
		,			
Autonomy	Students are able to independently deepen their	acquired knowledge in exercises			
	Students are able to acquire additional knowledge.		tent e.a. by using the	video recordings of th	
	lectures.	and to recapitate poorly understood con	terit e.g. by doing the	video recordings or a	
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120				
Assignment for the Following	General Engineering Science (German program): Speci	alisation Mechanical Engineering, Focus Energy	Systems: Compulsory		
Curricula	General Engineering Science (German program): Speci			Compulsory	
	General Engineering Science (German program): Speci	alisation Mechanical Engineering, Focus Material	ls in Engineering Scie	nces: 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 (English program): Specia	alisation Mechanical Engineering, Focus Energy S	Systems: Compulsory		
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Aircraft S	Systems Engineering: (Compulsory	
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Materials	s in Engineering Scien	ces: Compulsory	
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Mechatr	onics: Compulsory		
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Product	Development and Pro	duction: Compulsory	
	General Engineering Science (English program): Specia	alisation Mechanical Engineering, Focus Theoreti	cal Mechanical Engine	eering: Compulsory	
	Mechanical Engineering: Core qualification: Compulsor	у			
	Naval Architecture: Core qualification: Compulsory				



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

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



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

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



Module M0655: Computation	and Eluid Dynamica I			
Module M0655: Computation	onal Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L0235)		Lecture	2	3
Computational Fluid Dynamics I (L0419)		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematical Methods for Engineers - Fundamentals of Differential factoring and actions - Fundamental factoring actions - Fundamental factoring actions - Fundamental factoring actions - Fundamental factoring ac			
	 Fundamentals of Differential/integral calculus and series 	expansions		
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partial differer	ntial equations.		
Skills	The students are able develop appropriate numerical integra	tion in space and time for the governing	partial differential ed	quations. They can code
	computational algorithms in a structured way.			
Baraanal Compatance				
Personal Competence	The students can arrive at work regults in groups and decument	thom		
Social Competence	The students can arrive at work results in groups and document	triem.		
Autonomy	The students can independently englyse engreeshes to calving	anasifia problema		
Autonomy	The students can independently analyse approaches to solving	specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Mechanical Engineering, Focus Energy S	ystems: Compulsory	
Curricula	General Engineering Science (German program): Specialisation	n Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architecture: Compulso	ory	
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engineering, Foc	us Energy Systems: I	Elective Compulsory
	General Engineering Science (English program): Specialisation	Naval Architecture: Compulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program, 7 semester): Sp	·	-	
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engineering, Focu	ıs Energy Systems: E	Elective Compulsory
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Ele	• •		
	Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		

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



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



Module M0639: Gas and St	eam Power Plants				
Courses					
Title		Тур	Hrs/wk	СР	
as and Steam Power Plants (L0206)		Lecture	3	4	
Gas and Steam Power Plants (L0210)		Recitation Section (large)	2	2	
Module Responsible	Prof. Alfons Kather				
Admission Requirements	None				
Recommended Previous					
Knowledge	"Technical Thermodynamics I and II"				
	"Heat Transfer" """ """ """ """ """ """ """				
	"Fluid Mechanics"				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results			
Professional Competence					
Knowledge	The students can evaluate the development of the elec-	ctricity demand and the energy conversion routes	in the thermal power p	lant, describe the vario	
	types of power plant and the layout of the steam gene	erator block and determine the operation charact	eristics of the power pl	ant. Additionally they	
	describe the exhaust gas cleaning apparatus and oth fossil-fuelled power plants and regenerative (solar, wir			ssibilities of conventio	
	The students can on a basic level explain principles,			·	
	acidification, fine particulate or CO ₂ emissions and th				
	from interconnecting conventional power plants and i		otimal technical options	s for providing security	
	supply and network stability, also with economics cons	lacrea.			
Skills	The students are able, using theories and methods	of the energy technology from fossil fuels and b	ased on deep knowle	edge on the function a	
	construction of gas and steam power plants, to iden	tify basic associations in the production of heat	and electricity, so as	to develop conception	
	solutions. Through analysis of the problem and expo	sure to the inherent interconnections between h	eat and power genera	tion, the students will	
	endowed with the capability and methodology to dev				
	production of heat. From the technical basics the stud		rations on the electrici	ty mix composition wi	
	the energy-political triangle (economy, secure supply a	and environmental protection).			
	The students are able to highlight aspects of the o	design and development of power plant cycles	with the specialised	software suite EBSIL	
	Professional TM and to independently program simplifie	ed power plant process simulations.			
	The students are able to do simplified calculations of turbo machinery as either an overall plant or as individual stages.				
B	·	,	Ü		
Personal Competence	The students are able to solve subject-specific exercise	os in smalls groups and can procent their commo	n reculte orally		
Social Competence	The students are able to solve subject-specific exercise	es in smalls groups and can present their commo	i results orally.		
	The students are able to analyze suitable technical a	Iternatives to reduce the environmental and soci	al footprint of their eng	their engineering activities and	
	support the energy revolution effectively.				
Autonomy	The students assisted by the tutors will be able to de	velop alone simple simulation models and run w	vith these scenario ana	lyses. In this manner	
	theoretical and practical knowledge from the lecture			•	
	conditions highlighted. The students are able to ana				
	quantities and characteristic curves.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	Written examination of 120 min				
Assignment for the Following	General Engineering Science (German program): Spec	cialisation Energy and Enviromental Engineering:	Compulsory		
Curricula	General Engineering Science (German program): Spec	cialisation Mechanical Engineering, Focus Energy	Systems: Compulsory		
	General Engineering Science (German program, 7 sen	nester): Specialisation Energy and Enviromental E	Engineering: Compulso	ry	
	General Engineering Science (German program, 7 sen	nester): Specialisation Mechanical Engineering, F	ocus Energy Systems:	Elective Compulsory	
	Energy and Environmental Engineering: Core qualification				
	General Engineering Science (English program): Spec				
	General Engineering Science (English program): Spec				
	General Engineering Science (English program, 7 sem				
	General Engineering Science (English program, 7 sem		ocus Energy Systems: E	Elective Compulsory	
	Mechanical Engineering: Specialisation Energy System	ms: Compulsory			



Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:
	Electricity demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in thermal power plants
	Types of power plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials for power plants
	Location of power plants Only the state of the stat
	Solar shermal plants/geothermal plants/Carbon Capture and Storage plants
	These are complemented in the 2 nd part of the module by the more specialised issues:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus of the lecture and
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discus and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In
	critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.
	responsibility of all eligineers own actions are eliphasized and the potential extent of the different solutions presented cleanly.
	A multi-day excursion within the framework of the lecture is planned for those students that are interested. The students thus get direct contact with
	whole subject field of gas and steam power plants. Through discussions with plant personnel the students are able to obtain an overview on c
	operation problems and their solution approach.
	This activity hinges, however, upon the availability of support financing and as such it cannot always be guaranteed.
	This activity filliges, however, upon the availability of support financing and as such to almost always be guaranteed.
Literature	
Literature	Kalide: Kraft- und Arbeitsmaschinen
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990

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_	Desired to Out of the desired
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climatic effects are a special focus of the lecture an
	lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants and renewable energy sources are discu
	and the technical options for providing security of supply and network stability are presented, also under consideration of cost effectiveness. In
	critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, the awareness for
	responsibility of an engineer's own actions are emphasized and the potential extent of the different solutions presented clearly.
	responsibility of an engineer 3 own actions are emphasized and the potential extent of the unletent solutions presented deality.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM. With this tool small task
	solved on the PC, to highlight aspects of the design and development of power plant cycles. The students present their results orally and can afterw
	ask questions and get feedback. The course work has a positive effect on the students final grade.
Literature	Skripte
	Kalide: Kraft- und Arbeitsmaschinen
	Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985
	Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006
	Kugeler und Phlippen: Energietechnik. Springer-Verlag. 1990
	 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technis



Module M0684: Heat Trans	jer			
modulo modo irridat rrano.				
Courses				
Title		Тур	Hrs/wk	CP
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)		Recitation Section (large)	2	1
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- describe the different physical mechanism of fleat fransier,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
	- to analyse conflex fleat flatisler processes in a childar way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	and ordered the physics of rical transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	- solve excersises self-consistent and in small groups.			
Paragnal Compatance				
Personal Competence Social Competence	The students are able to discuss in small groups and develop an approximation	roach		
Social Competence	The students are able to discuss in small groups and develop an appr	oacii.		
Autonomy	The students are able to develop a complex problem self-consistent a	and analyse the results in a critical wa	ay. A qualified exchan	ge with other students is
	given.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
	6			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Mecl			
Curricula	General Engineering Science (German program): Specialisation Med		Systems: Compulsory	
	General Engineering Science (German program): Specialisation Biom		aal Maahaniaal Engina	oring: Compulator
	General Engineering Science (German program): Specialisation Mecl General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special Company of the Company o			
	Compulsory	Sandaron Moonamoar Engineering	, . Jour medicular IV	
	General Engineering Science (German program, 7 semester): Specia	lisation Biomedical Engineering: Cor	mpulsorv	
	General Engineering Science (English program): Specialisation Biom		p	
	General Engineering Science (English program): Specialisation Mech		anics: Compulsory	
	General Engineering Science (English program): Specialisation Mech	-		
	General Engineering Science (English program): Specialisation Mech			ering: Compulsory
	General Engineering Science (English program, 7 semester): Special	isation Mechanical Engineering, Foc	us Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering	, Focus Theoretical M	lechanical Engineering
	Compulsory			
	General Engineering Science (English program, 7 semester): Special	isation Biomedical Engineering: Con	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulsory	/		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engin	neering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	- Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014
	- Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000
	- Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



Course L0459: Heat Transfer	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1022: Reciprocating Machinery				
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Reciprocating Engines a	Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines (L0633)		1	1
	nd Turbomachinery - Part Reciprocating Engines (L0634)	Lecture Recitation Section (large)	1	1
Internal Combustion Engines I (L0059)		Lecture	2	2
Internal Combustion Engines I (L0639)		Recitation Section (large)	1	2
Module Responsible	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous	Thermodynamics, Mechanics, Machine Elements			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge Skills	As a result of the part module "Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals regarding power and working machinery and describe the qualitative and quantitative correlations of operating methods and efficiencies of multiple types of engines, compressors and pumps. They are able to utilize technical terms and parameters as well as aspects regarding the development of power density and efficiency, furthermore to give an overview of charging systems, fuels and emissions. The students are able to select specific types of machinery and assess design related and operational problems. As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design. The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design.			
Personal Competence Social Competence Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation M	Mechanical Engineering, Focus Energy	Systems: Compulsory	
Curricula	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanical Engineering, Fo	cus Energy Systems:	Compulsory
	General Engineering Science (English program): Specialisation M	lechanical Engineering, Focus Energy S	Systems: Compulsory	
	General Engineering Science (English program, 7 semester): Spe	cialisation Mechanical Engineering, Foo	cus Energy Systems: (Compulsory
	Mechanical Engineering: Specialisation Energy Systems: Compul	con		



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

Course L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Christopher Friedrich Wirz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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



Course L0639: Internal Combustion Engines I	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Wolfgang Thiemann
Language	DE
Cycle	SoSe
Content	Calculation of tasks to:
	Design of of motors Real process calculation Charging methods Kinematics of the crank mechanism Forces in the engine
Literature	Vorlesungsskript



Focus Aircraft Systems Engineering

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

Master Energy Engineering or an eco	onomical oriented master study.			
Module M0597: Advanced I	Mechanical Engineering Design			
Courses				
Title Advanced Mechanical Engineering Design	(1,111)	Typ Lecture	Hrs/wk	CP 2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Fundamentals of Mechanical Engineering Design 			
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the followin	a learning results		
Professional Competence	After taking part successionly, students have reached the following	g rearring results		
·	After pessing the module students are able to:			
Knowledge	After passing the module, students are able to:			
	 explain complex working principles and functions of mach 	nine elements and of basic elements of flui	dics,	
	 explain requirements, selection criteria, application scena 	rios and practical examples of complex m	achine elements,	
	 indicate the background of dimensioning calculations. 			
Skills	After passing the module, students are able to:			
	 accomplish dimensioning calculations of covered machin 	e elements,		
	 transfer knowledge learned in the module to new require 			
	 recognize the content of technical drawings and schemati 			
	evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss technical information in the le	ecture supported by activating methods.		
Autonomy				
	Students are able to independently deepen their acquired			
	Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the			
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Eneray S	ystems: Compulsorv	
Curricula	General Engineering Science (German program): Specialisation			Compulsory
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Product D	evelopment and Pro	duction: Compulsory
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Theoretic	al Mechanical Engin	eering: Compulsory
	General Engineering Science (English program): Specialisation		-	- · · ·
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Aircraft Sy	stems Engineering: (Compulsory
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			•
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Product D	evelopment and Prod	duction: Compulsory
	General Engineering Science (English program): Specialisation			
	Mechanical Engineering: Core qualification: Compulsory	-	,	•
	Naval Architecture: Core qualification: Compulsory			



Course L0264: Advanced Mechanic	al Engineering Design II
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe SoSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced Mechanical Engineering Design Facility
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears Cliding begings
	Sliding bearings Calculations of hydrotetic systems (fluidics)
	Calculations of hydrostatic systems (fluidics)
Literature	
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen
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Course L0265: Advanced Mechanical Engineering Design II		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0262: Advanced Mechanic	al Engineering Design I	
	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
	DE	
Language		
Cycle	WiSe	
Content	Advanced Mechanical Engineering Design I & II	
	Lecture	
	Fundamentals of the following machine elements:	
	Linear rolling bearings	
	Axes & shafts	
	Seals	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	Crank drives	
	Sliding bearings	
	Elements of fluidics	
	Exercise	
	Calculation methods of the following machine elements:	
	 Linear rolling bearings 	
	Axes & shafts	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	Epicyclic gears	
	• Crank gears	
	Sliding bearings	
	Calculations of hydrostatic systems (fluidics)	
Literature		
	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. 	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.	
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 	
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.	
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.	
	Sowie weitere Bücher zu speziellen Themen	
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Course L0263: Advanced Mechanical Engineering Design I		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0596: Advanced	Machanical Design Project			
Module M0590. Advanced	wechanical Design Project			
Courses				
Title	Typ Hrs/wk CP			
Advanced Mechanical Design Project (L03	266) Practical Course 4 6			
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mechanical Engineering: Design Advanced Mechanical Engineering Position			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	After passing the module, students are able to:			
	express the procedure for systematically handling of			
	• complex design tasks ,			
	describe working principles, their use and combination possibilities,			
	explain guidelines for designing for function and manufacturing,			
	explain advanced use-oriented knowledge of machine elements.			
Skills	After passing the module, students are able to:			
	analyze complex tasks and develop principle solutions using sketches,			
	convert principle solutions into a detailed design,			
	use methods to design and solve engineering design tasks systematically and solution-oriented, create a technical desumpatation including all page cases technical desurings to understood the functions of the custom.			
	 create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail. 			
	document cardinations of selected madnine elements deany and in detail.			
Personal Competence				
Social Competence	After passing the module, students are able to:			
	a present and discuss solutions and technical drawings within groups			
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course 			
	Tellectule own results in the work groups of the course			
Autonomy	After passing the module, students are able to:			
	independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods,			
	 independently solve complex design projects, while motivating tremserves, acquiring necessary knowledge and selecting appropriate methods, to independently solve problems. 			
	to independently solve problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory			
Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory			
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: 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 (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		
Тур	Practical Course	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff, Dr. Jens Schmidt, Dr. Volkert Wollesen	
Language	DE	
Cycle	WiSe	
Content	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.	
	Getriebekonstruktion in Einzelarbeit	
	Erarbeitung von Lösungsprinzipien	
	Berechnung von Maschinenelementen	
	Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten	
	 Erstellung einer ausführlichen Dokumentation 	
	Lösungsfindung	
	Methodische Erarbeitung von prinzipiellen Lösungskonzepten	
	Erstellen einer Dokumentation	
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.	
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 	
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.	
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.	
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.	
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.	
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.	
	Sowie weitere Bücher zu speziellen Themen	



Module M0564: Simulation	of Dynamic Systems and Reliability			
Courses				
Title		Тур	Hrs/wk	CP
Simulation of Dynamic Systems (L0170)		Lecture	2	2
Simulation of Dynamic Systems (L1301)		Recitation Section (small)	1	1
Reliability of Dynamic Systems (L0172)		Lecture	2	2
Reliability of Dynamic Systems (L1302)		Recitation Section (small)	1	1
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	none			
Recommended Previous	Fundatmentals of mechanics, control theory and electrical en	gineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for m	odeling, simulation and optimization of compl	ex mechanical syster	ns.
Skills	Students are able to apply modern algorithms for modeling of	mechanical systems.		
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed 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 cou	rse of study.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min.			
Assignment for the Following	General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Mechatro	nics: Compulsory	
Curricula	General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (German program): Specialisat	ion Mechanical Engineering, Focus Theoretic	al Mechanical Engin	eering: Compulsory
	General Engineering Science (English program): Specialisati	on Mechanical Engineering, Focus Aircraft Sy	stems Engineering:	Compulsory
	General Engineering Science (English program): Specialisati	on Mechanical Engineering, Focus Mechatron	nics: Compulsory	•
	General Engineering Science (English program): Specialisati	on Mechanical Engineering, Focus Theoretica	al Mechanical Engine	ering: Compulsory
	Mechanical Engineering: Specialisation Aircraft Systems Eng	ineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Comp			
	Mechanical Engineering: Specialisation Theoretical Mechani	cal Engineering: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complement	ary Course Core Studies: Elective Compulsor	у	

Course L0170: Simulation of Dynamic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab [®] and Simulink [®]	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	

Course L1301: Simulation of Dynamic Systems		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0172: Reliability of Dynamic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
	Methods for prediction and validation of life cycle of components and systems Modeling, simulation, parameter identification Load data analysis and damage accumulation Fatigue testing	
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412	

Course L1302: Reliability of Dynamic Systems		
	Typ Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0599: Integrated I	Product Development and Lightweight De	sign			
Courses					
Title		Тур	Hrs/wk	CP	
CAE-Team Project (L0271)		Problem-based Learning	2	2	
Development of Lightweight Design Produ	cts (L0270)	Lecture	2	2	
Integrated Product Development I (L0269)		Lecture	2	2	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous	Advanced Knowledge about engineering design:				
Knowledge	Fundamentals of Mechanical Engineering Design				
	Mechanical Engineering: Design				
	Advanced Mechanical Engineering Design				
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence Knowledge	After completing the module, students are capable of:				
	 explaining the functional principle of 3D-CAD-Sys 	stome DDM and EEM Systems			
	describing the interaction of the different CAE-Sys	· ·			
Skills					
	After completing the module, students are able to:				
	Alter completing the module, students are able to.				
	 evaluate different CAD- and PDM-Systems with re 	egards to the desired requirements such as class	sification schemes and	product structuring	
	 design an exemplary product using CAD-,PDM- a 	nd/or FEM-Systems with shared workload			
Personal Competence					
Social Competence	After completing the module, students are able to:				
	To develop a project plan and allocate work appropriate to a state of a factor and a second and allocate work appropriate to a second a second and a second a se		o discussions		
	 Present project results as a team for instance in a 	presentation			
Autonomy	Students are capable of:				
	 independently adapt to a CAE-Tool and complete 	a given practical task with it			
		-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination Examination duration and scale	90				
	General Engineering Science (German program): Specia	disation Machanical Engineering Facus Aircraft	Sustana Engineering:	Compulació	
Assignment for the Following Curricula	General Engineering Science (German program): Special				
	General Engineering Science (German program, 7 seme		•		
	General Engineering Science (German program, 7 sen		•		
	Compulsory	3 11 3	,	.,	
	General Engineering Science (English program): Specia	lisation Mechanical Engineering, Focus Aircraft S	Systems Engineering: (Compulsory	
	General Engineering Science (English program): Specia				
	General Engineering Science (English program, 7 semes	ster): Specialisation Mechanical Engineering, Fo	cus Aircraft Systems E	ngineering: Compulso	
	General Engineering Science (English program, 7 sem	nester): Specialisation Mechanical Engineering.	, Focus Product Deve	lopment and Producti	
	Compulsory				
	Mechanical Engineering: Specialisation Product Develop	' '			
	Mechanical Engineering: Specialisation Aircraft Systems		ro Compulation		
	Product Development, Materials and Production: Technic	cal Complementary Course Core Studies: Electiv	re Compulsory		



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

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

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



Module M0767: Aeronautic	al Systems			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Aircraft Systems (L0741		Lecture	2	2
Fundamentals of Aircraft Systems (L0742)		Recitation Section (small)	1	1
Air Transportation Systems (L0591)		Lecture	2	2
Air Transportation Systems (L0816)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	none			
Recommended Previous	Basics of mathematics, mechanics and thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	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 a	and ways of working in different subsystems in the	ne air transport is acq	uired.
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system			
	implementation. In addition, they can apply the learned m	nethods for the design and assessment of subs	systems of the air tra	nsportation system in the
	context of the overall system.	•		
Personal Competence				
Social Competence	Students are made aware of interdisciplinary communication in groups.			
Autonomy	Students are able to independently analyze different system	n concepts and their technical implementation a	s well as to think sys	tem oriented.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following	General Engineering Science (German program): Specialis	sation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
Curricula	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engineering, Foo	cus Aircraft Systems E	Engineering: Compulsory
	General Engineering Science (English program): Specialis	ation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engineering, Foc	us Aircraft Systems E	ngineering: Compulsory
	Logistics and Mobility: Specialisation Logistics and Mobility	: Elective Compulsory	•	
	Logistics and Mobility: Specialisation Logistics and Mobility Mechanical Engineering: Specialisation Aircraft Systems E			

Course L0741: Fundamentals of Aircraft Systems		
Course Lo741. Fundamentals of All	u at dystems	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	SoSe	
Content	- Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials	
	- Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems	
Literature	- Shevell, R. S.: Fundamentals of Flight	
	- TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis	
	- Wild: Transport Category Aircraft Systems	

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



Course L0591: Air Transportation Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	SoSe	
Content	1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air traffic management 9. Environmental aspects of air transportation 10. Future perspectives of air transport	
Literature	 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4 P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0 	

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



Focus Materials in Engineering Sciences

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

technological problems.				
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Mechanical Engineering Design	n II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design	n II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering Design	n I (L0262)	Lecture	2	2
Advanced Mechanical Engineering Design	n I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Machanical Engineering Design			
Knowledge	Fundamentals of Mechanical Engineering Design Machanica			
	Mechanics Fundamentals of Materials Science			
	Tarradinarial of Materials Solories			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and functions of mac			
	explain requirements, selection criteria, application scen	arios and practical examples of complex ma	achine elements,	
	indicate the background of dimensioning calculations.			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered machin	ne elements,		
	transfer knowledge learned in the module to new require			
	recognize the content of technical drawings and schema			
	evaluate complex designs, technically.			
Personal Competence				
Social Competence	Students are able to discuss technical information in the	lecture supported by activating methods.		
		, , ,		
Autonomy	Students are able to independently deepen their acquire	nd knowledge in exercises		
	Students are able to acquire additional knowledge an		ntea by using the	video recordings of the
	lectures.	to recapitalate poorly understood come	in e.g. by using the	video recordings or the
	lootaros.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			ces: Compulsory
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	• •	•	
	General Engineering Science (German program): Specialisation			eering: Compulsory
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	•		
	General Engineering Science (English program): Specialisation			ces: Compulsory
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Mechatron	nics: Compulsory	
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Product De	evelopment and Prod	luction: Compulsory
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Theoretica	al Mechanical Engine	ering: Compulsory
	Mechanical Engineering: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



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

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



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

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



Module M0988: Structural M	<i>l</i> laterials			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanical Properties of	Materials (L1090)	Lecture	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are resp	consible for the mechanical behaviour of metals.	They acquire basic knowl	egde in modelling of the
	materials behaviour. Furthermore, the students learn	about the behaviour of metals under static and	dynamic loads. The stude	nts get to know the most
	important welding technologies and the corresponding	ng systems. They learn about the influence of wel	ding on the materials and	design.
Skills	The students know the mechanical properties of me	etals and the underlying principles. They are al	ale to name the influencing	a factors on the welding
Onno	behaviour of steel materials.	calle and the andenying principles. They are as	ne to name the initiaenom	g lactors on the welding
	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	e and system components for a defined applica	tion. They are able to dime	ension weld joints within
	design tasks.			
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Mechanical Engineering, Focus Mate	erials in Engineering Scien	ces: Compulsory
Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanical Engine	ering, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Sp	ecialisation Mechanical Engineering, Focus Mate	rials in Engineering Scien	ces: Compulsory
	General Engineering Science (English program, 7	7 semester): Specialisation Mechanical Engine	ering, Focus Materials in	Engineering Sciences:
	Compulsory			
	Mechanical Engineering: Specialisation Materials in	Engineering Sciences: Compulsory		

Course L1090: Fundamentals of Mechanical Properties of Materials		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Norbert Huber, Dr. Erica Lilleodden	
Language	EN	
Cycle	SoSe	
Content	1. Introduction and overview	
	2. Bonding and crystallography, stress, strain, linear elasticity	
	3. Plasticity of metallic materials	
	4. Dislocations: Structure, stress, strain, strain energy	
	5. Dislocations: Motion and forces	
	6. Partial dislocations, dislocation interactions, jogs and kinks	
	7. Strengthening mechanisms	
	8. Introduction to modelling of materials behaviour, classification of	
	phenomena	
	9. Linear and nonlinear elasticity	
	10. Plasticity, tensile loading, cyclic loading	
	11. Viscoelasticity, effects of loading history, creep, relaxation	
	12. Viscoplasticity, overstress, rate sensitivity of metallic materials	
	13. Identification of material parameters	
Literature	Hull and Bacon: Introduction to Dislocations (1984)	
	G. Gottstein: Physik. Grundlagen der Materialk. (2001)	
	N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998)	
	P. Haupt: Cont. Mechanics and Theory of Materials (2002)	



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



Module M0662: Numerical I	Mathematics I			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematik I + II for Engineering Students (german or basic MATLAB knowledge	r english) or Analysis & Linear Algebra I + II for	Technomathematici	ans
Educational Objectives	After taking part successfully, students have reached the follow	owing learning results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration explain their core ideas, repeat convergence statements for the numerical methods explain aspects for the practical execution of numerical methods.	thods,		finding problems and to
Skills	Students are able to			
	implement, apply and compare numerical methods use justify the convergence behaviour of numerical methos select and execute a suitable solution approach for a	ods with respect to the problem and solution al	gorithm,	
Personal Competence				
Social Competence	Students are able to			
oodal oompetende	Citation are able to			
	work together in heterogeneously composed teams foundations and support each other with practical asp			edge), explain theoretica
Autonomy	Students are capable			
	to assess whether the supporting theoretical and prac to assess their individual progess and, if necessary, to		or in a team,	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Computer Science: Compulsory		
Curricula	General Engineering Science (German program): Specialisa		anics: Compulsory	
	General Engineering Science (German program): Specialisa			nces: Compulsory
	General Engineering Science (German program): Specialisa	tion Biomedical Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulso	ory	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engineering	g, Focus Materials i	n Engineering Sciences
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Foo	us Biomechanics: Co	ompulsory
	Bioprocess Engineering: Specialisation A - General Bioproce			
	Computer Science: Specialisation Computational Mathemati			
	Electrical Engineering: Core qualification: Elective Compulso			
	General Engineering Science (English program): Specialisat	, ,		
	General Engineering Science (English program): Specialisat		pion Committee	
	General Engineering Science (English program): Specialisat			noos: Compulson
	General Engineering Science (English program): Specialisat General Engineering Science (English program, 7 semester)			ices. Compulsory
	General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) Compulsory	·	-	n Engineering Sciences
	General Engineering Science (English program, 7 semester)	: Specialisation Biomedical Engineering: Com	pulsory	
	General Engineering Science (English program, 7 semester)	: Specialisation Mechanical Engineering, Foci	us Biomechanics: Co	mpulsory
	Computational Science and Engineering: Core qualification:	Compulsory		
	Process Engineering: Specialisation Process Engineering: E	lective Compulsory		



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

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



Module M1009: Material Sci	ience Laboratory			
Courses				
Title		Тур	Hrs/wk	CP
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)	D (D E	Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler none			
Admission Requirements Recommended Previous	none			
Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
· · · · · · · · · · · · · · · · · · ·	After taking part successionly, students have reached the following	learning results		
Professional Competence Knowledge	Students are able to give a summary of the technical details of exp	poriments in the area of materials sais	noos and illustrato rooms	otivo rolationshins They
Knowieage	are capable of describing and communicating relevant problem		·	
	process of solving practical problems and present related results.	s and questions using appropriate te	cillical language. They	can explain the typical
	process or solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on mater	ial sciences to the process of solving	practical problems. The	y identify and overcome
	typical problems during the realization of experiments in the conte	xt of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to conduc	ct experiments in the context of materi	als sciences. They are a	ble to effectively present
codal competence	and explain their results alone or in groups in front of a qualified a	·	ars soronocs. They are a	old to checulvely present
	3.14			
Autonomy	Students are capable of solving problems in the context of mater		re. They are able to fill g	aps in as well as extent
	their knowledge using the literature and other sources provided by	the supervisor.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Colloquium			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson			
Assignment for the Following	General Engineering Science (German program): Specialisation N	Mechanical Engineering, Focus Materi	als in Engineering Scien	ces: Compulsory
Curricula	General Engineering Science (German program): Specialisation N	Mechanical Engineering, Focus Produ	ct Development and Proc	duction: Compulsory
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engineer	ring, Focus Materials in	Engineering Sciences:
	Compulsory			
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	Compulsory	15 1 1 0 1		
	Mechanical Engineering: Specialisation Product Development and			
	Mechanical Engineering: Specialisation Materials in Engineering	• •	ina Campula i i	
	Product Development, Materials and Production: Technical Comp	iementary Course Core Studies: Electi	ive Compulsory	

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



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



Module M1005: Enhanced I	Fundamentals of Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Metallic Materials (L1086		Lecture	2	3
Fundamentals of Ceramic and Polymer Ma		Lecture	2	2
Fundamentals of Ceramic and Polymer Ma	aterials (L1234)	Recitation Section (la	arge) 1	1
Module Responsible	Prof. Gerold Schneider			
Admission Requirements	None			
Recommended Previous	Module "Fundamentals of Materials Science"			
Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to give an enhanced overview	over the following topics		
	in metals, polymers and ceramics: Atomic bonds, cr	ystal and amorphous structures, defects	, electrical and mass transpor	t, microstructure and phase
	diagrams. They are capable to explain the correspon	ding technical terms.		
Skills	The students are able to apply the appropriate physic	al and chemical methods for the above n	nentioned subjects.	
Personal Competence				
Social Competence				
Autonomy	The students are capable to understand independe evaluate the profoundness of their knowledge.	ntly the structure and propeties of ceram	ics, metals and polymers. The	ey should be able to critally
Warkland in House	Independent Study Time 110. Study Time in Lecture	70		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 6	7.0		
Credit points				
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Sp			
Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Focus Materials	in Engineering Sciences:
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Er	ngineering, Focus Product De	velopment and Production:
	Compulsory			
	General Engineering Science (English program): Spe	ecialisation Mechanical Engineering, Focu	us Materials in Engineering Sci	iences: Compulsory
	General Engineering Science (English program, 7	semester): Specialisation Mechanical	Engineering, Focus Materials	in Engineering Sciences:
	Compulsory			
	General Engineering Science (English program, 7 Compulsory	semester): Specialisation Mechanical Er	ngineering, Focus Product De	velopment and Production
	Mechanical Engineering: Specialisation Materials in	Engineering Sciences: Compulsorv		
	Technomathematics: Specialisation III. Engineering S			
	Technomathematics: Core qualification: Elective Cor			
		·pJ		

Course L1086: Fundamentals of Me	Course L1086: Fundamentals of Metallic Materials		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Jörg Weißmüller, Prof. Patrick Huber		
Language	DE		
Cycle	SoSe		
Content			
Literature	Vorlesungsskript		
	W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7		



Course I 1000: Fundamentals of Co	newig and Dahman Materials
Course L1233: Fundamentals of Ce	
Typ Hrs/wk	Lecture 2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	1. Einführung
	Natürliche "Keramiken" – Steine
	"Künstliche" Keramik – vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al2O3-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik
	Sprühtrockner
	3. Formgebung
	Arten der Formgebung
	Pressen (0 - 15 % Feuchte)
	Gießen (> 25 % Feuchte)
	Plastische Formgebung (15 - 25 % Feuchte)
	4. Sintern
	Triebkraft des Sinterns
	Effekt von gekrümmten Oberflächen und Diffusionswegen
	Sinterstadien des isothermen Festphasensinterns
	Herring scaling laws
	Heißisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten
	Bruchzähigkeit – Linear-elastische Bruchmechanik
	Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften
	Anwendungen
	Veremiasha langulaiter
	Keramische lonenleiter
	Ionische Leitfähigkeit
	Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	D. Munz, T. Fett, Ceramics, Springer, 2001
	555 5 50
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe
	Werkstoffkunde Kunststoffe G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €



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



Focus Mechatronics

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

Mechatronics or an economical oriented master study.				
Module M0597: Advanced	Mechanical Engineering Design			
Courses				
Title Advanced Mechanical Engineering Design) II (I 0264)	Typ Lecture	Hrs/wk	CP 2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design		Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Design			
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,		
Knowledge	After passing the module, students are able to:			
	- The parameter of the parameter and the paramet			
	 explain complex working principles and functions of mach 	ine elements and of basic elements of flui	dics,	
	explain requirements, selection criteria, application scena	rios and practical examples of complex ma	achine elements,	
	 indicate the background of dimensioning calculations. 			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered machine	e elements,		
	transfer knowledge learned in the module to new requirent	nents and tasks (problem solving skills),		
	 recognize the content of technical drawings and schemati 	c sketches,		
	 evaluate complex designs, technically. 			
Personal Competence				
Social Competence	Students are able to discuss technical information in the le	cture supported by activating methods.		
Autonomy				
	Students are able to independently deepen their acquired knowledge in exercises.			
	Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the			
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Energy Sy	ystems: Compulsory	
Curricula	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Materials	in Engineering Scier	nces: Compulsory
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (German program): Specialisation	Mechanical Engineering, Focus Product D	evelopment and Pro	duction: Compulsory
	General Engineering Science (German program): Specialisation		-	eering: Compulsory
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation N			
	General Engineering Science (English program): Specialisation			ces: Compulsory
	General Engineering Science (English program): Specialisation	0 0,	. ,	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation	Mechanical Engineering, Focus Theoretica	al Mechanical Engine	eering: Compulsory
	Mechanical Engineering: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			



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

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



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

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



Module M0708: Electrical E	ngineering III: Circuit Theory and Transients			
Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	Prof. Arne Jacob			
Admission Requirements	none			
Recommended Previous	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating ele periodic signals. They know the methods for transient analysis of			
	frequency behaviour and the synthesis of passive two-terminal-circu			•
Skille	The students are able to calculate currents and voltages in linear n	atworks by means of basic methods	also when driven hy n	ariodic signals. They s
Skills	able to calculate transients in electrical circuits in time and frequency			
	analyse and to synthesize the frequency behaviour of passive two-te		respective transferribe	naviour. They are able
	analyse and to synthesize the nequency benaviour of passive two to	Timilar Ground.		
Personal Competence				
Social Competence	Students work on exercise tasks in small guided groups. They are er	acouraged to present and discuss the	ir results within the aro	up.
cosiai composino		noonaged to procent and alcouse the	roodilo maiir aro gro	ap.
Autonomy	The students are able to find out the required methods for solving the	e given practice problems. Possibilit	ies are given to test the	eir knowledge during t
	lectures continuously by means of short-time tests. This allows the	m to control independently their edu	cational objectives. Th	ney can link their gain
	knowledge to other courses like Electrical Engineering I and Mathen	natics I.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Specialisation Ele	ctrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Me	chanical Engineering, Focus Mechati	ronics: Compulsory	
	General Engineering Science (German program, 7 semester): Speci	alisation Mechanical Engineering, Fo	ocus Mechatronics: Cor	mpulsory
	General Engineering Science (German program, 7 semester): Speci	alisation Electrical Engineering: Com	pulsory	
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation Elec	ctrical Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Med	chanical Engineering, Focus Mechatr	onics: Compulsory	
	General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Engineering, Fo	cus Mechatronics: Con	npulsory
	General Engineering Science (English program, 7 semester): Specia	alisation Electrical Engineering: Comp	pulsory	
	Computational Science and Engineering: Specialisation Engineerin	g Sciences: Elective Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Electiv			
	Technomathematics: Specialisation III. Engineering Science: Electiv	e Compulsory		



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

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



ourses				
itle		Тур	Hrs/wk	СР
imulation of Dynamic Systems (L0170)		Lecture	2	2
imulation of Dynamic Systems (L1301)		Recitation Section (small)	1	1
teliability of Dynamic Systems (L0172)		Lecture	2	2
eliability of Dynamic Systems (L1302)		Recitation Section (small)	1	1
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	none			
Recommended Previous	Fundatmentals of mechanics, control theory and e	electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for modeling, simulation and optimization of complex mechanical systems.			
Skills				
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups.			
	-			
Autonomy	y Students are able to recognize and improve knowledge deficits independently.			
	With instructor assistance, students are able to ev	aluate their own knowledge level and define a further co	urse of study.	
Workload in Hours				
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min.			
Assignment for the Following	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
Curricula		Specialisation Mechanical Engineering, Focus Aircraft S		Compulsory
	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Theoretic	cal Mechanical Engin	eering: Compulsory
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Theoretic	al Mechanical Engine	eering: Compulsory
	Mechanical Engineering: Specialisation Aircraft S	systems Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatro			
	Mechanical Engineering: Specialisation Theoretic			
	Mechatronics: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical C	omplementary Course Core Studies: Elective Compulsor	rv	

Course L0170: Simulation of Dynamic Systems	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	none
Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	Modeling
	Model Identifikation
	Numerical Methods in simulation
	Applications and examples in Matlab [®] and Simulink [®]
Literature	Skript zur Veranstaltung
	Weitere Literatur in der Veranstaltung

Course L1301: Simulation of Dynam	ourse L1301: Simulation of Dynamic Systems	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0172: Reliability of Dynamic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
	Methods for prediction and validation of life cycle of components and systems Modeling, simulation, parameter identification Load data analysis and damage accumulation Fatigue testing	
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412	

Course L1302: Reliability of Dynamic Systems	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	none
Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0777: Semicondu	ctor Circuit Design			
Courses				
Title		Тур	Hrs/wk	СР
Semiconductor Circuit Design (L0763)		Lecture	3	4
Semiconductor Circuit Design (L0864)		Recitation Section (small)	1	2
Module Responsible	Prof. Wolfgang Krautschneider			
Admission Requirements	none			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics			
	dasics of physics			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	 Students are able to explain the functionality 	of different MOS devices in electronic circuits		
		circuits and can discuss their advantages and disadva	ntagos	
		ry circuits and can explain their functionality and spec		
	Students have solid knowledge about memo Students are able to explain how analog circle.		ilications.	
	Students know the appropriate fields for the u			
	cademe in the appropriate notes in the	acc of Sipolar various.		
Skills				
		different MOS devices and can define the parameters of least and can design different to a set least a size of least and can design different to a set least a size of least and can design different to a set least a size of least a size of least and can design different to a set least a size of least a size of least and can define the parameters of least and can defin	of electronic circuits.	
		ircuits and can design different types of logic circuits.	222	
	Students can use MOS devices, operational	amplifiers and bipolar transistors for specific application	JIIS.	
Personal Competence				
Social Competence	Studente ere oble week efficiently in beterees	anagua tagma		
	 Students are able work efficiently in heteroge Students working together in small groups or 	an solve problems and answer professional questions		
	- Oldderna working together in anian groups of	an solve problems and answer professional questions	J.	
Autonomy				
Autonomy	 Students are able to assess their level of known 	wledge.		
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 6	56		
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): S	posialization Floatrical Engineering: Compulsory		
Curricula		pecialisation Electrical Engineering, Compuisory pecialisation Mechanical Engineering, Focus Mechatr	onice: Compulsory	
Ourricula		semester): Specialisation Electrical Engineering: Com		
		semester): Specialisation Mechanical Engineering, Fo		oulsorv
	Computer Science: Specialisation Computer and Science			,
	Electrical Engineering: Core qualification: Compulso			
	General Engineering Science (English program): Sp	•		
		pecialisation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
		emester): Specialisation Electrical Engineering: Comp		
		emester): Specialisation Mechanical Engineering, Foo	•	oulsory
	Computational Science and Engineering: Specialisa	, ,		-
	Mechanical Engineering: Specialisation Mechatroni			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Core qualification: Elective Co	mpulsory		
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		



Course L0763: Semiconductor Circuit	it Design
Тур Ц	Lecture
Hrs/wk 3	3
CP 4	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer F	Prof. Wolfgang Krautschneider
Language [DE
Cycle S	SoSe
Content Literature F	Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Calling-down of CMOS circuits and further perfomance improvements Coperational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits B. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/ibook/index.cfm/bok_id/319955 URL: http://ebooks.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. Wolfgang Krautschneider	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0854: Mathematic	es IV			
Courses				
Fitle .		Тур	Hrs/wk	CP
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential		Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential		Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Mathen	matics IV. They are able to explain them using appro	priate examples.	
	 Students can discuss logical connections between 	en these concepts. They are capable of illustrating t	hese connections w	ith the help of exampl
	 They know proof strategies and can reproduce th 	nem.		
Skills				
	Students can model problems in Mathematics IV	with the help of the concepts studied in this course	. Moreover, they are	e capable of solving the
	by applying established methods.			
	 Students are able to discover and verify further lo 	gical connections between the concepts studied in	the course.	
	 For a given problem, the students can develop ar 	nd execute a suitable approach, and are able to crit	cally evaluate the re	esults.
Personal Competence				
Social Competence				
	Students are able to work together in teams. They	y are capable to use mathematics as a common lan	guage.	
	 In doing so, they can communicate new concept 	ts according to the needs of their cooperating partr	ners. Moreover, they	can design example
	check and deepen the understanding of their pee	ers.		
Autonomy				
	 Students are capable of checking their understa 	anding of complex concepts on their own. They can	specify open ques	tions precisely and ki
	where to get help in solving them.			
	 Students have developed sufficient persistence to 	o be able to work for longer periods in a goal-orient	ed manner on hard	problems.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
		iona (1)		
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equat	· · · · · · · · · · · · · · · · · · ·		
Assignment for the Following	General Engineering Science (German program): Specia			
Curricula	General Engineering Science (German program): Specia			
	General Engineering Science (German program): Specia		al Mechanical Engin	eering: Compulsory
	General Engineering Science (German program): Specia	• •		
	General Engineering Science (German program, 7 seme	, ,	,	
	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical Engineering, Focu	is Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineer
	Compulsory			
	General Engineering Science (German program, 7 seme	ester): Specialisation Naval Architecture: Compulso	ry	
	Computer Science: Specialisation Computational Mathe	matics: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specia	alisation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specia			
	General Engineering Science (English program): Specia		ics: Compulsorv	
	General Engineering Science (English program): Specia	* *		eering: Compulsorv
	General Engineering Science (English program, 7 seme	* *	-	3 32
	General Engineering Science (English program, 7 seme			mpulsorv
	General Engineering Science (English program, 7 se			
			. Jour mediculodi	conamoar Eligilieei
	Congret Engineering Science (English program 7 come	otor), Consisting News Architecture Commit	.,	
	General Engineering Science (English program, 7 seme		у	
	Computational Science and Engineering: Specialisation			
	Computational Science and Engineering: Specialisation			
	Mechanical Engineering: Specialisation Theoretical Med			
	Mechanical Engineering: Specialisation Mechatronics: C	Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complete	mentary Course Core Studies: Flective Compulsory		



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations	
	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	R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000	
	P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998	
	A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002	

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
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1038: Complex Functions	
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	Main features of complex analysis
	 Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation
Literature	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998



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

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



Focus Product Development and Production

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

	Mechanical Engineering Design			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Mechanical Engineering Design	ı II (L0264)	Lecture	2	2
Advanced Mechanical Engineering Design		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design	n I (L0262)	Lecture	2	2
Advanced Mechanical Engineering Design	n I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engineering Design			
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
	Troduction Engineering			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	 explain complex working principles and functions of m 	achine elements and of basic elements of flui	dice	
	explain requirements, selection criteria, application so			
	indicate the background of dimensioning calculations.		,	
	gg			
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of covered mac	hine elements,		
	transfer knowledge learned in the module to new requ	irements and tasks (problem solving skills),		
	recognize the content of technical drawings and schen	natic sketches,		
	 evaluate complex designs, technically. 			
Developed Commissioner				
Personal Competence				
Social Competence	Students are able to discuss technical information in th	e lecture supported by activating methods.		
Autonomy				
Autonomy	Students are able to independently deepen their acqui	ired knowledge in exercises.		
	Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the			
	lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Energy S	ystems: Compulsory	
Curricula	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Aircraft Sy	stems Engineering:	Compulsory
	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Materials	in Engineering Scien	nces: Compulsory
	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Product D	evelopment and Pro	duction: Compulsory
	General Engineering Science (German program): Specialisati	on Mechanical Engineering, Focus Theoretic	al Mechanical Engin	eering: Compulsory
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Energy Sy	stems: Compulsory	
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Aircraft Sy	stems Engineering:	Compulsory
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Materials	in Engineering Scien	ces: Compulsory
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Mechatror	nics: Compulsory	
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Product D	evelopment and Pro	duction: Compulsory
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Theoretica	al Mechanical Engine	ering: Compulsory
	I			
	Mechanical Engineering: Core qualification: Compulsory			



Course L0264: Advanced Mechanic	al Engineering Design II
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
Content	Advanced wechanical Engineering Design Lati
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Dubbal Tasabanbanb Stadas Masabisanban Casta V. H. Faldbaren 1815a N. Colons Mada alla St. A. San
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschine alle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. The second of the DNN News and Mark the second of the secon
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Kanthali in alle N. Brit. O. Brit. W. Stringer Verlag. Kanthali in alle N. Brit. O. Brit. W. Stringer Verlag. Kanthali in alle N. Brit. O. Brit. W. Stringer Verlag. Kanthali in alle N. Brit. O. Brit. W. Stringer Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen
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Course L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

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



Module M0596: Advanced	Mechanical Design Project
Courses	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Project (L02	· · · · · · · · · · · · · · · · · · ·
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	
Knowledge	Mechanical Engineering: Design
	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to:
	express the procedure for systematically handling of
	complex design tasks ,
	describe working principles, their use and combination possibilities,
	explain guidelines for designing for function and manufacturing,
	explain advanced use-oriented knowledge of machine elements.
	L
Skills	After passing the module, students are able to:
	analyze complex tasks and develop principle solutions using sketches,
	convert principle solutions into a detailed design,
	 use methods to design and solve engineering design tasks systematically and solution-oriented,
	 create a technical documentation including all necessary technical drawings to understand the functions of the system,
	document calculations of selected machine elements clearly and in detail.
Personal Competence	
	After passing the module, students are able to:
,	
	present and discuss solutions and technical drawings within groups,
	reflect the own results in the work groups of the course
Autonomy	After passing the module, students are able to:
	independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate method independently solve analysis and selecting appropriate method
	to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Examination	Written exam
Examination duration and scale	180
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compuls
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineer
	Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulso
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Product
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineer
	Compulsory
	Mechanical Engineering: Core qualification: Compulsory



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



Module M1009: Material Sci	ience Laboratory			
Courses				
Title		Тур	Hrs/wk	СР
Companion Lecture for Materials Science	Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235)		Laboratory Course	4	4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of exp	eriments in the area of materials scie	nces and illustrate respe	ective relationships. They
	are capable of describing and communicating relevant problems	and questions using appropriate to	echnical language. They	can explain the typical
	process of solving practical problems and present related results.			
Skills		-1: 4- 4b	avertical avaluation. The	
Skills	The students can transfer their fundamental knowledge on materi typical problems during the realization of experiments in the contex		practical problems. The	ly identify and overcome
	typical problems during the realization of experiments in the comes	tt of material sciences.		
Personal Competence				
Social Competence	Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are able to effectively present			
	and explain their results alone or in groups in front of a qualified au	dience.		
Autonomy	Students are capable of solving problems in the context of materi	ala asianasa using provided literatu	ro. Thou are able to fill a	one in se well se extent
Autonomy	their knowledge using the literature and other sources provided by	• ,	e. They are able to lill g	japs iii as well as exterit
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	are supervisor.		
	6			
Credit points Examination				
	Colloquium			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson	and the standard from Market	alada Faria a da a Oria	0
Assignment for the Following	General Engineering Science (German program): Specialisation M			
Curricula	General Engineering Science (German program): Specialisation M			
	General Engineering Science (German program, 7 semester): Compulsory	Specialisation Mechanical Engineer	ing, Focus Materials in	Engineering Sciences:
	General Engineering Science (English program): Specialisation Me	ochanical Engineering, Feeus Materia	als in Engineering Scien	nos: Compulsory
	General Engineering Science (English program): Specialisation Mil			
	General Engineering Science (English program, 7 semester): \$		·	
	Compulsory	Sposialisation Moonanioal Engineer	g, . oodo matoriais iii	gcoming colonices.
	Mechanical Engineering: Specialisation Product Development and	Production: Compulsory		
	Mechanical Engineering: Specialisation Materials in Engineering S			
	Product Development, Materials and Production: Technical Comple		ive Compulsory	
	c,	,	r,	

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



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



Module M0726: Production	Technology			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Machine Tools (L0689)		Lecture	3	3
Forming and Cutting Technology (L0613)		Lecture	2	2
Forming and Cutting Technology (L0614)		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze		·	
Admission Requirements	None			
Recommended Previous	without major course assessment			
Knowledge				
	internship recommended			
	Previous knowledge in mathematics, mechanics and electrical	engineering		
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to			
	explain the basics of chip formation and mechanisms a		and to the	
	explain methods and parameters for design and analys			
	explain technical concepts of machine tool building and			
	explain types, constructions and functions of CNC-mac	thines and give an overview on multi-mac	hine systems.	
	explain equipment components.			
Skills	Students are able to			
	 select tool geometry, cutting materials, process parame 	eters and appropriate measuring techniqu	e in accordance with the	requirements.
	estimate occurring forces and temperatures during chip	o formation.		•
	select appropriate machine tools for machining and cre			
	assess the quality of a machine tools and to detect wea	, ,		
Personal Competence				
Social Competence	Students are able to			
	develop solutions in a production environment with qua	alified personnel at technical level and rep	present decisions.	
Autonomy	Students are able to			
	 interpret independently cutting processes. 			
	create independently NC programs.			
	select independently machine tools by reference to appropriate tools.	propriate requirements		
	assess own strengths and weaknesses in general.			
	assess their learning progress and define gaps to be in	nproved		
	 assess their rearring progress and define gaps to be in assess possible consequences of their actions. 			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): Specialisation	on Mechanical Engineering, Focus Produ	ct Development and Pro	duction: Compulsorv
Curricula	General Engineering Science (German program, 7 semeste			
	Compulsory	, ,	J	,
	General Engineering Science (English program): Specialisation	on Mechanical Engineering, Focus Produc	ct Development and Prod	duction: Compulsory
	General Engineering Science (English program, 7 semester		·	
	Compulsory	,. Specialisation Medianical Engineenii	g, i ocus i ioduci Devel	opment and Froducti
	Mechanical Engineering: Specialisation Product Development	t and Production: Compulsory		
			ivo Compulsari	
	Product Development, Materials and Production: Technical Co	implementary Course Core Studies: Elect	ive Compulsory	



Course L0689: Fundamentals of Ma	chine Tools
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
Literature	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006



Course L0613: Forming and Cutting Technology			
Тур	ecture		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wolfgang Hintze		
Language	DE		
Cycle	WiSe		
Content	Thermomechanical Principles and Models of Machining Chip Formation, Forces, Temperature and Tribology process Wear mechanisms and wear patterns Machinability by Cutting and Forming, Specific Problems of Light Weight Structures Cutting Material and Coatings Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools		
Literature	Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002) Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004) König, W., Klocke, F.; Fertigungsverfahren Bd. 4 Massivumformung, 4. Auflage, VDI-Verlag (1996) König, W., Klocke, F.; Fertigungsverfahren Bd. 5 Blechbearbeitung, 3. Auflage, VDI-Verlag (1995) Klocke, F., König, W.; Fertigungsverfahren Schleifen, Honen, Läppen, 4. Auflage, Springer Verlag (2005) König, W., Klocke, F.: Fertigungsverfahren Drehen, Fräsen, Bohren, 7. Auflage, Springer Verlag (2002)		

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



Module M0599: Integrated I	Product Development and Lightweight Desig	n			
Courses					
Title		Тур	Hrs/wk	СР	
CAE-Team Project (L0271)		Problem-based Learning	2	2	
Development of Lightweight Design Production		Lecture	2	2	
Integrated Product Development I (L0269)		Lecture	2	2	
Module Responsible Admission Requirements	None				
Admission Requirements	None				
Recommended Previous	Advanced Knowledge about engineering design:				
Knowledge	Fundamentals of Mechanical Engineering Design				
	Mechanical Engineering: Design				
	Advanced Mechanical Engineering Design				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence					
Knowledge	After completing the module, students are capable of:				
	explaining the functional principle of 3D-CAD-Systems	s, PDM- and FEM-Systems			
	 describing the interaction of the different CAE-Systems 	s in the product development process			
Skills					
o.i.no					
	After completing the module, students are able to:				
	Avaluate different CAD- and PDM-Systems with regard	de to the decired requirements such as classif	ication schemes and	product structuring	
	 evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification schemes and product structuring design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload 				
		,			
Paragral Competence					
Personal Competence Social Competence	After completing the module, students are able to:				
Social Competence	After completing the module, students are able to.				
	To develop a project plan and allocate work appropriation.		discussions		
	 Present project results as a team for instance in a pres 	sentation			
Autonomy	Students are capable of:				
	 independently adapt to a CAE-Tool and complete a gi 	ven practical task with it			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
	Written exam				
Examination duration and scale	90 General Engineering Science (German program): Specialisation	ion Mochanical Engineering Focus Aircraft C	vetome Engineering	Compulson	
Assignment for the Following Curricula	General Engineering Science (German program): Specialisat General Engineering Science (German program): Specialisat				
	General Engineering Science (German program, 7 semester)				
	General Engineering Science (German program, 7 semeste	1 0 0	•	,	
	Compulsory				
	General Engineering Science (English program): Specialisati				
	General Engineering Science (English program): Specialisati	0 0,		, ,	
	General Engineering Science (English program, 7 semester):		-		
	General Engineering Science (English program, 7 semeste Compulsory	ii). Opecialisation Mechanical Engineering, l	rocus Product Devel	opinent and Production	
	Mechanical Engineering: Specialisation Product Developmer	nt and Production: Compulsory			
	Mechanical Engineering: Specialisation Aircraft Systems Eng				
	Product Development, Materials and Production: Technical C		Compulsory		



Course L0271: CAE-Team Project	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content Practical Introduction in the used software systems (Creo, Windchill, Hyperworks) Team formation, allocation of tasks and generation of a project plan Collective creation of one product out of CAD models supported by FEM calculations and PDM system Manufacturing of selected parts using 3D printer Presentation of results Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern power of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern power of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern power of the product out of several CAD parts models using a PDM system including FEM calculations.	
Literature	-

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

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



Focus Theoretical Mechanical Engineering

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

	Mechanical Engineering Design	<u> </u>			
Courses					
Title		Тур	Hrs/wk	СР	
Advanced Mechanical Engineering Design	II (L0264)	Lecture	2	2	
Advanced Mechanical Engineering Design	II (L0265)	Recitation Section (large)	2	1	
Advanced Mechanical Engineering Design	I (L0262)	Lecture	2	2	
Advanced Mechanical Engineering Design	1 (L0263)	Recitation Section (large)	2	1	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous	Fundamentals of Mechanical Engineering Design				
Knowledge	Mechanics				
	Fundamentals of Materials Science				
	Production Engineering				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	<u> </u>			
Knowledge	After passing the module, students are able to:				
			d:		
	 explain complex working principles and functions of m explain requirements, selection criteria, application sc 				
	 indicate the background of dimensioning calculations. 		ternine elements,		
	indicate the background of differentiationing calculations.	•			
Skills	After passing the module, students are able to:				
	accomplish dimensioning calculations of covered made.	chine elements,			
	 transfer knowledge learned in the module to new requ 	irements and tasks (problem solving skills),			
	 recognize the content of technical drawings and scher 	matic sketches,			
	 evaluate complex designs, technically. 				
Personal Competence					
Social Competence					
coolai compotento	Students are able to discuss technical information in the students are able to discuss technical information.	ne lecture supported by activating methods.			
Autonomy					
	Students are able to independently deepen their acqu	ired knowledge in exercises.			
	Students are able to acquire additional knowledge	and to recapitulate poorly understood conte	nt e.g. by using the	video recordings of the	
	lectures.				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points	6				
Examination	Written exam				
Examination duration and scale	120				
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory				
Curricula	General Engineering Science (German program): Specialisat				
	General Engineering Science (German program): Specialisat			nces: Compulsory	
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory				
	General Engineering Science (German program): Specialisat				
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory 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): Specialisati General Engineering Science (English program): Specialisati				
	General Engineering Science (English program): Specialisati General Engineering Science (English program): Specialisati	0 0	0 0	ices. Compuisory	
	General Engineering Science (English program): Specialisati General Engineering Science (English program): Specialisati			duction: Compulsory	
			·		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory				
Naval Architecture: Core qualification: Compulsory					



Course L0264: Advanced Mechanic	al Engineering Design II		
	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle	SoSe		
Content	Advanced Mechanical Engineering Design I & II		
	Lecture		
	Fundamentals of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Seals		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank drives		
	Sliding bearings		
	Elements of fluidics		
	xercise		
	Calculation methods of the following machine elements:		
	Linear rolling bearings		
	Axes & shafts		
	Clutches & brakes		
	Belt & chain drives		
	Gear drives		
	Epicyclic gears		
	Crank gears		
	Sliding bearings		
	Calculations of hydrostatic systems (fluidics)		
Literature	Dubbal Tasabashash Washingsham Costs V. H. Faldharen 1915a N. Costa Walter all J. M. Costa		
	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenbaug Den der Weltenbaug Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.		
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente: Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. 		
	h., , .p. 3		
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. 		
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		
	 Maschinenelemente 1-2, Schlecht, B., Fearson Verlag, aktuelle Auflage. Maschinenelemente – Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. 		
	 Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. 		
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	Sowie weitere Bücher zu speziellen Themen		

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



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

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



Module M0684: Heat Trans	fer			
Courses				
Courses				
Title		Тур	Hrs/wk	CP
Heat Transfer (L0458)		Lecture	3	5
Heat Transfer (L0459)	D. Andreas Massicalists	Recitation Section (large)	2	1
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge Educational Objectives	After taking part successfully, students have reached the following le	arning regulte		
	After taking part successionly, students have reached the following le	arriing results		
Professional Competence Knowledge	The students are able to			
Knowiedge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	,			
	- to analyse comlex heat transfer processes in a critical way.			
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processes,			
	and the second s			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an app	proach.		
Autonomy	The students are able to develop a complex problem self-consistent	and analyse the results in a critical wa	av A qualified exchan	ne with other students is
rationomy	given.	and analyse the results in a shacar we	ay. 71 quamica exeriari	ge with other stadents is
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisation Med	chanical Engineering, Focus Biomech	anics: Compulsory	
Curricula	General Engineering Science (German program): Specialisation Med		Systems: Compulsory	
	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program): Specialisation Med		-	
	General Engineering Science (German program, 7 semester): Special General Engineering Science (German program, 7 semester): Special			
	Compulsory	ecialisation Mechanical Engineering.	, rocus meoretical i	lechanical Engineering.
	General Engineering Science (German program, 7 semester): Specia	alisation Biomedical Engineering: Cor	mpulsorv	
	General Engineering Science (English program): Specialisation Bior			
	General Engineering Science (English program): Specialisation Med		anics: Compulsory	
	General Engineering Science (English program): Specialisation Med			
	General Engineering Science (English program): Specialisation Med	hanical Engineering, Focus Theoretic	al Mechanical Engine	ering: Compulsory
	General Engineering Science (English program, 7 semester): Specia	lisation Mechanical Engineering, Foc	us Energy Systems: C	ompulsory
	General Engineering Science (English program, 7 semester): Spi	ecialisation Mechanical Engineering,	Focus Theoretical M	Mechanical Engineering:
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia	llisation Biomedical Engineering: Com	npulsory	
	Mechanical Engineering: Specialisation Energy Systems: Compulso			
	Mechanical Engineering: Specialisation Theoretical Mechanical Eng	ineering: Compulsory		

Course L0458: Heat Transfer	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods
Literature	
	 - Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 - Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996



Course L0459: Heat Transfer	
Тур	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



ourses				
itle		Тур	Hrs/wk	СР
imulation of Dynamic Systems (L0170)		Lecture	2	2
imulation of Dynamic Systems (L1301)		Recitation Section (small)	1	1
teliability of Dynamic Systems (L0172)		Lecture	2	2
eliability of Dynamic Systems (L1302)		Recitation Section (small)	1	1
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	none			
Recommended Previous	Fundatmentals of mechanics, control theory and e	lectrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calculations for modeling, simulation and optimization of complex mechanical systems.			
Skills	Students are able to apply modern algorithms for modeling of mechanical systems.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small m	nixed groups.		
Autonomy	Students are able to recognize and improve knowledge deficits independently.			
	With instructor assistance, students are able to eva	aluate their own knowledge level and define a further co	urse of study.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min.			
Assignment for the Following	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Mechatro	onics: Compulsory	
Curricula	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Aircraft S	Systems Engineering:	Compulsory
	General Engineering Science (German program):	Specialisation Mechanical Engineering, Focus Theoretic	cal Mechanical Engin	eering: Compulsory
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Aircraft S	ystems Engineering:	Compulsory
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (English program):	Specialisation Mechanical Engineering, Focus Theoretic	al Mechanical Engine	eering: Compulsory
	Mechanical Engineering: Specialisation Aircraft Specialisation	ystems Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatro	nics: Compulsory		
	Mechanical Engineering: Specialisation Theoretic	al Mechanical Engineering: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Co	omplementary Course Core Studies: Elective Compulsor	rv	

Course L0170: Simulation of Dynamic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	Modeling	
	Model Identifikation	
	Numerical Methods in simulation	
	Applications and examples in Matlab [®] and Simulink [®]	
Literature	Skript zur Veranstaltung	
	Weitere Literatur in der Veranstaltung	

Course L1301: Simulation of Dynamic Systems	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	none
Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L0172: Reliability of Dynamic Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
	Methods for prediction and validation of life cycle of components and systems Modeling, simulation, parameter identification Load data analysis and damage accumulation Fatigue testing	
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412	

Course L1302: Reliability of Dynamic Systems	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	none
Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses		
Fitle	~	CP
Advanced Mechanical Design Project (L02		6
Module Responsible		
Admission Requirements		
Recommended Previous Knowledge	Mechanical Engineering: Design	
Kilowiedge	Advanced Mechanical Engineering Design	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge		
Tulemouge	The pacety at the case, state the are as a second	
	express the procedure for systematically handling of	
	complex design tasks ,	
	describe working principles, their use and combination possibilities,	
	explain guidelines for designing for function and manufacturing,	
	explain advanced use-oriented knowledge of machine elements.	
Skills	After passing the module, students are able to:	
	analyze complex tasks and develop principle solutions using sketches,	
	convert principle solutions into a detailed design, was methods to design and solve presing design tooks evertemetically and solution oriented.	
	use methods to design and solve engineering design tasks systematically and solution-oriented, secrets a technical degree partial including all processors technical drawings to understood the functions of the guestion.	
	 create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail. 	
	• document calculations of selected machine elements clearly and in detail.	
Personal Competence	,	
Social Competence	After passing the module, students are able to:	
	procept and discuss solutions and technical drawings within groups	
	present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course.	
	reflect the own results in the work groups of the course	
Autonomy	After passing the module, students are able to:	
	independently calve complex decign projects, while mativating themselves, acquiring percessary knowledge and colecting apply	ropriato mothod
	 independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appre- to independently solve problems. 	торпате птетпои
	to independently solve problems.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Credit points	6	
Examination	Written exam	
Examination duration and scale	180	
Assignment for the Following	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu	ulsory
Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production	n: 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	ering: Compulso
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development	nt and Producti
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	nical Engineeri
	Compulsory	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compu	-
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production	
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering:	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Enginee	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmer	nt and Producti
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Focus Theoretical Mechanical Engineering, Focus Theoretical Mechanical Engineering	nical Engineeri
	Compulsory	
	Mechanical Engineering: Core qualification: Compulsory	



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



Module M0854: Mathematic	es IV			
Courses				
Title		Тур	Hrs/wk	CP
Differential Equations 2 (Partial Differential	Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential		Recitation Section (small)	1	1
Differential Equations 2 (Partial Differential	Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	none			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge				
	Students can name the basic concepts in Mathema			
	Students can discuss logical connections between		hese connections w	ith the help of exampl
	They know proof strategies and can reproduce there	m.		
Skills	Students can model problems in Mathematics IV w	with the help of the concepts studied in this source	Maragyar thay are	a concluing the
	by applying established methods.	ntil the help of the concepts studied in this course	e. Moreover, triey are	capable of solving the
		ical connections between the concepts at idiad in	the course	
	Students are able to discover and verify further logical and a students are developed and a students are developed as a student are developed as a students are developed as a student are developed as a students are develo			alta
	 For a given problem, the students can develop and 	r execute a sultable approach, and are able to chi	ically evaluate the re	esuits.
Personal Competence				
Social Competence	 Students are able to work together in teams. They a 	are canable to use mathematics as a common lan	auago	
				, oon dooign overnle
	In doing so, they can communicate new concepts A control and do so on the confidence of the concepts. The control and do so on the confidence of the control and the co		iers. Moreover, triey	can design example
	check and deepen the understanding of their peers	S.		
Autonomy	Students are capable of checking their understand	ding of complex concents on their own. They ca	n enecify onen gues	tions precisely and k
		uning of complex concepts on their own. They can	i specily open ques	lions precisely and k
	where to get help in solving them.	ha abla ta wark far langar nariada in a gaal ariant	ad mannar an hard	arablama
	 Students have developed sufficient persistence to l 	be able to work for longer periods in a goar-onem	eu manner on naru j	problems.
Westler die Herre	Indexes dead On the Transit Control of the Control			
	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Differential Equation	ns 2)		
Assignment for the Following	General Engineering Science (German program): Speciali	isation Electrical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Special	isation Mechanical Engineering, Focus Mechatro	nics: Compulsory	
	General Engineering Science (German program): Speciali	isation Mechanical Engineering, Focus Theoretic	al Mechanical Engin	eering: Compulsory
	General Engineering Science (German program): Speciali	isation Naval Architecture: Compulsory		
	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Engineering: Compo	ulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engineering, Foci	us Mechatronics: Co	mpulsory
	General Engineering Science (German program, 7 sem	nester): Specialisation Mechanical Engineering,	Focus Theoretical	Mechanical Engineer
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Naval Architecture: Compulso	ry	
	Computer Science: Specialisation Computational Mathem	atics: Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialis	sation Electrical Engineering: Compulsory		
	General Engineering Science (English program): Specialis			
	General Engineering Science (English program): Specialis		ics: Compulsory	
	General Engineering Science (English program): Specialis	• •		eering: Compulsory
	General Engineering Science (English program, 7 semest			3 32
	General Engineering Science (English program, 7 semest			mpulsory
		, ,		
	General Engineering Science (English program, 7 sem	esier). Specialisation Mechanical Engineering,	rocus meoretical	wechanical Engineel
	Compulsory	Considiration News LA with the Co.		
	General Engineering Science (English program, 7 semest		У	
	Computational Science and Engineering: Specialisation E			
	Computational Science and Engineering: Specialisation C			
	Mechanical Engineering: Specialisation Theoretical Mech	anical Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
		entary Course Core Studies: Flective Compulson		



Course L1043: Differential Equations 2 (Partial Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of the theory and numerical treatment of partial differential equations	
	Examples of partial differential equations	
	First order quasilinear differential equations	
	Normal forms of second order differential equations	
	Harmonic functions and maximum principle	
	Maximum principle for the heat equation	
	Wave equation	
	Liouville's formula	
	Special functions	
	Difference methods	
	Finite elements	
Literature	R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000	
	P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998	
	A. Tveito, R. Winther: Einführung in partielle Differentialgleichungen, Springer Verlag, Berlin, Heidelberg, New York, 2002	

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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1038: Complex Functions	
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	Main features of complex analysis
	Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation
Literature	 R. Ansorge, H. J. Oberle: Mathematik für Ingenieure, Band 2; Verlag Wiley-VCH, Berlin, Weinheim, New York, 2000 P. Henrici, R. Jelsch: Komplexe Analysis für Ingenieure, Birkhäuser Verlag, Basel, 1998



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

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



Specialization Process Engineering

Module M0886: Fundamen	tals of Process Engineering			
•				
Courses				
Title		Тур	Hrs/wk	CP
Introduction into Process Engineering/Biop		Lecture	2	1
Fundamentals of Technical Drawing and Materials (L0830)		Lecture	1	1
Fundamentals of Technical Drawing and N	Materials (L1495)	Recitation Section (large)	1	2
Module Responsible	Technologie (L0326) Module Responsible Prof. Michael Schlüter			2
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Knowledge	After passing this module the students have the ability to:			
		and blanca and a set of the		
	give an overview of the most important fields on proce overlain some working methods for different fields in process.			
	explain some working methods for different fields in process.	rocess engineening.		
Skills	After passing this module the students should have the ability	/to:		
	list and outline the most important fields of process en			
	 read and prepare an engineering drawing, 			
	explain the most important technologies for wastewate			
	scheme typical chemical and biotechnological processes independently with the aid of pointers.			
Personal Competence				
Social Competence	The students are able to			
	 work out results in groups and document them, 			
	provide appropriate feedback and handle feedback or	n their own performance constructively.		
Autonomy	The students are able to estimate their progress of learning	ng by themselves and to deliberate their l	ack of knowledge in P	rocess Engineerina a
,	Bioprocess Engineering.	3 - ,		3 11 3 1
	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa	tion Bioprocess Engineering: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisat	ion Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisati	ion Chemical Engineering: Compulsory		
	Technomathematics: Specialisation Engineering Science: Ele	ective Compulsory		
	Process Engineering: Core qualification: Compulsory			

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



Course L0830: Fundamentals of Teo	chnical Drawing and Materials
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards) Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)
Literature	 Hesser, Wilfried; Hoischen, Hans: "Technisches Zeichnen", 33., überarb. und aktualisierte Aufl, Cornelsen Verlag, Berlin, 2011 Labisch, Susanna; Weber, Christian: "Technisches Zeichnen", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013 Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014

Course L1495: Fundamentals of Technical Drawing and Materials		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Marko Hoffmann	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0326: Environmental Technologie		
Тур	ecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta	
Language	DE	
Cycle	WiSe	
Content	1. Introductory seminar on environmental science: 2. Environmental impact and adverse effects 3. Wastewater technology 4. Air pollution control 5. Noise protection 6. Waste and recycling management 7. Soil and ground water protection 8. Renewable energies 9. Resource conservation and energy efficiency	
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)	



Module M0937: Physical Ch	nemictry			
Module Mossi. Filysical Ci	iennau y			
Courses				
Title		Тур	Hrs/wk	СР
Physical Chemistry (L0833)		Lecture	2	2
Physical Chemistry (L0835) Laboratory Course 2 2			2	
Environmental Assessment (L0860)	Lecture 2 2			2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemist	ry, physics for engineers and mathematics I-III.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts of mass-, heat- and momentum transfer.			
	- to interpret phase diagrams and affiliate kinetic rate	e laws.		
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.			
	- assess new applications with respect to environmental sustainability.			
	- abstract their knowldege to related issues to condu	ct thermodynamical, electrochemical and kinetic calc	ulations.	
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and	document experiments according to scientific guideli	nes in small groups.	
Autonomy	Students are able to assess their knowldege continu	uously on their own by exemplified practice. Students	are able to apply their	r knowldege discretely to
	plan, prepare and conduct experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	General Engineering Science (German program): S	pecialisation Chemical Engineering: Compulsory		
Curricula				
	Process Engineering: Core qualification: Compulsor	у		

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



Course L0835: Physical Chemistry		
Тур	Laboratory Course	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Hans-Ulrich Moritz	
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	
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	

Course L0860: Environmental Assessment		
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		
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)	



Module M0536: Fundamentals of Fluid Mechanics				
Courses				
Title		Тур	Hrs/wk	CP
Fundamentals of Fluid Mechanics (L0091)		Lecture	2	4
Exercises in Fluid Mechanics for Process	Engineering (L0092)	Recitation Section (large)	1	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous				
Knowledge	Working with force balances			
	Simplification and solving of partial differential equations			
	Integration			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students are able to:			
	explain the difference between different types = f f =			
	 explain the difference between different types of flow give an overview for different applications of the Reynol 	de Transport-Theorem in process ansince	ring	
	explain simplifications of the Continuity- and Navier-Sto			
	- explain simplifications of the continuity and reavier clo	nes Equation by using physical boundary	ooriditions	
Skills	The students are able to			
	describe and model incompressible flows mathematical	lv		
	reduce the governing equations of fluid mechanics by s		ons e.g. by integration	
	notice the dependency between theory and technical as	·		
	use the learned basics for fluid dynamical applications in	•		
		, , ,		
Personal Competence				
Social Competence	The students			
	 are capable to gather information from subject related, p 	professional publications and relate that in	formation to the contex	of the lecture and
	able to work together on subject related tasks in small g	roups. They are able to present their resul	ts effectively in English	(e.g. during small group
	exercises)			
Autonomy	The students are able to			
Autonomy	The Students are able to			
	 search further literature for each topic and to expand the 	eir knowledge with this literature,		
	 work on their exercises by their own and to evaluate the 	ir actual knowledge with the feedback.		
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following	General Engineering Science (German program): Specialisation	n Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation			
Juliouu	General Engineering Science (German program): Specialisation		Compulsory	
	Bioprocess Engineering: Core qualification: Compulsory	5, 3 = =g =g	1	
	Energy and Environmental Engineering: Core qualification: Co	mpulsory		
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation		Compulsory	
	General Engineering Science (English program): Specialisation	n Chemical Engineering: Compulsory		
	Technomathematics: Specialisation Engineering Science: Elec	tive Compulsory		



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

Course L0092: Exercises in Fluid Mechanics for Process Engineering				
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Michael Schlüter			
Language	DE			
Cycle	SoSe			
Content	The Exercise-Lecture will bridge the gap between the theoretical content from the lecture and the practical calculations for the homework exercises. For			
	this aim a special exercise is calculated at the blackboard that shows how the theoretical knowledge from the lecture can be used to solve real problems			
	in Process Engineering.			
Literature	Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.			
	2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006.			
	3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994			
	 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 			
	 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 			
	6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007			
	7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009			
	8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007			
	9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008			
	10. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006			
	11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882.			
	12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011			



Prof. Irina Smirnova None Mathematics, Physical Chemistry, Thermodynamics I and II	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1	CP 2
None	Lecture Recitation Section (small)	2 1	2
None	Recitation Section (large)	1	2
None			2
After taking part successfully, students have reached the following	g learning results		
 They learn how state variables are influenced by the mixi Moreover, the students learn how phase equilibria can b liquid, solid) coexist in equilibrium. Furthermore the funda For different phase equilibria, several examples relevant interpreting the equilibria are taught. 	ng of compounds and learn concepts to que described mathematically and which phe imentals of reaction equilibria are taught. for different kinds of processes are shown a	antitatively describe in any occur is and the necessary kn	these properties. If different phases (vapor
 Applying treir knowledge, the students are able to identify the correct equation for the determination of the equilibrium state and know now simplify these equations meaningfully. The students know models which can be used to determine the properties of the system in the equilibrium state and they are able to solve resulting mathematical relations. For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well as model parameters literature sources. Beside pure compound properties the students are capable of describing the properties of mixtures. The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomena. Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many separation and reaction processes in chemical engineering. 			
 The students are able to find necessary information self-reliantly in literature sources and to judge their quality. During the semester the students are able to check their learning progress continuously in exercises. Based on this knowledge the students can adept their learning process. 			
Independent Study Time 124, Study Time in Lecture 56		-	-
6		_	
General Engineering Science (German program): Specialisation General Engineering Science (German program): Specialisation Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation	Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory		
	Starting from the very basics of thermodynamics, the stude. They learn how state variables are influenced by the mixit. Moreover, the students learn how phase equilibria can be liquid, solid) coexist in equilibrium. Furthermore the funda. For different phase equilibria, several examples relevant interpreting the equilibria are taught. Applying their knowledge, the students are able to ident simplify these equations meaningfully. The students know models which can be used to determ resulting mathematical relations. For specific applications, they are able to self-reliantly find literature sources. Beside pure compound properties the students are capable. The students know how to visualize phase equilibria grape. Based on their knowledge, the students are able to unprocesses in chemical engineering. The students are able to find necessary information self-reliantly their learning process. The students are able to find necessary information self-reliantly their learning process. Independent Study Time 124, Study Time in Lecture 56 Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation.	 They learn how state variables are influenced by the mixing of compounds and learn concepts to query Moreover, the students learn how phase equilibria can be described mathematically and which phe liquid, solid) coexist in equilibriam. Furthermore the fundamentals of reaction equilibria are taught. For different phase equilibria, several examples relevant for different kinds of processes are shown interpreting the equilibria are taught. Applying their knowledge, the students are able to identify the correct equation for the determinat simplify these equations meaningfully. The students know models which can be used to determine the properties of the system in the equesuiting mathematical relations. For specific applications, they are able to self-reliantly find necessary physico-chemical properties of literature sources. Beside pure compound properties the students are capable of describing the properties of mixtures. The students know how to visualize phase equilibria graphically and they know how to interpret the Based on their knowledge, the students are able to understand fundamental concepts that are processes in chemical engineering. The students are able to find necessary information self-reliantly in literature sources and to judge the During the semester the students are able to check their learning progress continuously in exercise adept their learning process. Independent Study Time 124, Study Time in Lecture 56 Written exam Iominutes; theoretical questions and calculations General Engineering Science (German program): Specialisation Chemical Engineering: Compulsory General Engineering Science (Fenglish program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Chemical Engineering: Compulsory 	Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic of They learn how state variables are influenced by the mixing of compounds and learn concepts to quantitatively describe. Noreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur i liquid, solidy coexist in equilibrian, Furthermore the fundamentals of reaction equilibria are taught. For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary known interpreting the equilibria are taught. Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrium simplify these equations meaningfully. The students know models which can be used to determine the properties of the system in the equilibrium state and the resulting mathematical relations. For specific applications, they are able to self-reliantly find necessary physico-chemical properties of compounds as well literature sources. Beside pure compound properties the students are capable of describing the properties of mixtures. The students know how to visualize phase equilibria graphically and they know how to interpret the occurring phenomen. Based on their knowledge, the students are able to understand fundamental concepts that are the basis for many processes in chemical engineering.



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

Course I 0440. The weed we will all	
Course L0140: Thermodynamics III	
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	 Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure
Literature	 Jürgen Gmehling, Bârbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Course L0142: Thermodynamics III	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	1. Introduction: Applications of thermodynamics of mixtures 2. Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity 3. Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule 4. Equations of state: virial equations, van-der-Waals equation, generalized equations of state 5. Mixing properties: ideal and real mixtures, excess properties, partial molar properties 6. Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition 7. Gas-liquid-equilibria: equilibrium condition, Henry-coefficient 8. GE-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC 9. Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems 10. Solid-liquid-equilibria: equilibrium condition, binary systems 11. Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature 12. Osmotic pressure
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.



Module M0890: Practical Training in Process Engineering				
Courses				
Title		Тур	Hrs/wk	CP
Practical Training in Measurement Technic	ques (L1005)	Laboratory Course	3	4
Measurement Methods in Process Engine	eering (L0840)	Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	none			
Recommended Previous	Undergraduate lectures of mathematics and physics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The Students are able to describe the usual measur	ement techniques and measurement methods in p	rocess engineering and	to describe their fields of
	applications.			
Skills	Skills The students are able to use different measurement technologies in Process Engineering and Bioprocess Engineering at experiment		perimental facilities. They	
	are able to evaluate the measured data result-oriented and to estimate the accuracy of the measurements.			
Personal Competence				
Social Competence	The students are able to discuss a given problem in small groups and to develop and present an approach.			
Autonomy	The students are able to implement measurement techniques by themselves and to develop a program for the measurements.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale				
Assignment for the Following	General Engineering Science (German program): Sp	pecialisation Chemical Engineering: Compulsory		
Curricula	General Engineering Science (English program): Sp	ecialisation Chemical Engineering: Compulsory		

purse L1005: Practical Training in Measurement Techniques		
Тур	Laboratory Course	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Michael Schlüter, Dozenten des SD E, Dozenten des SD B, Dozenten des SD V, Dozenten des SD M	
Language	DE	
Cycle	SoSe	
Content	Several practical courses concerning measurement technologies are given by the different Instituts of the department Process Engineering and	
	Bioprocess Engineering.	
Literature	Individual or each practical course	



Course L0840: Measurement Metho	ods in Process Engineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language Cycle	DE WiSe
Content	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
Literature	 Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055-3. Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.



Module M0672: Signals and	d Systems			
Courses				
Title		Тур	Hrs/wk	CP
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0433)		Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	The modul is an introduction to the theory of signals and syste	ms. Good knowledge in maths as cover	ed by the moduls Ma	thematik 1-3 is expected
Knowledge	Further experience with spectral transformations (Fourier series,		•	•
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linea	(, ,	,	, ,
	to apply the fundamental transformations of continuous-time and			
	and systems mathematically in both time and image domain. I		in time domain and	image domain which ar
	caused by the transition of a continuous-time signal to a discrete			
Skills	The students are able to describe and analyse deterministic sign	·	-	
	can analyse and design basic systems regarding important prop		sponse, stability, linea	rity etc They can asses
	the impact of LTI systems on the signal properties in time and free	quency domain.		
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information from app	•	trol their level of know	vledge during the lectur
	period by solving tutorial problems, software tools, clicker system	l		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Specialisation			
Curricula	General Engineering Science (German program): Specialisation		mpulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation		ompulsory	
	General Engineering Science (German program): Specialisation			
	General Engineering Science (German program): Specialisation	Biomedical Engineering: Compulsory		
	Computer Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation		ompuisory	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation General Engineering Science (English program): Specialisation		mouleon	
			iipuls0iy	
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation			
	General Engineering Science (English program): Specialisation Computational Science and Engineering: Core qualification: Cor			
	Mechatronics: Core qualification: Compulsory	привоту		
	Technomathematics: Specialisation Engineering Science: Electiv	ve Compulsory		
	recimomatiematics. Specialisation Engineering Science: Electr	re Compuisory		



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

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



Courses				
Γitle		Тур	Hrs/wk	CP
Bioprocess Engineering - Fundamentals (Lecture	2	3
Bioprocess Engineering- Fundamentals (L		Recitation Section (large)	2	1 2
Bioprocess Engineering - Fundamental Pr		Laboratory Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	none			
Recommended Previous	none, module "organic chemistry", module "fundamentals	for process engineering"		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	Students are able to describe the basic concepts of bit			
	microorganisms, as well as to differentiate different types	·		
	processes in bioreactors can be explained. The student	s are capable to explain fundamental bioproce	ess management, ste	rilization technology
	downstream processing in detail.			
Skills	After successful completion of this module, students shoul	d be able to		
	describe different kinetic approaches for growth ar			
	predict qualitatively the influence of energy general		tn innibition on the fe	rmentation process
	analyze bioprocesses on basis of stoichiometry and distribution in the basis of stoichiometry and distribution in the storage and the sto		!!:	- h: a) da - a dh
	 distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to devel as to apply them to current biotechnical problem propose solutions to complicated biotechnological problems and to deduce the corresponding models 			obic) to compare ther
	propose solutions to complicated biotechnological	problems and to deduce the corresponding mod	ieis	
	to explore new knowledge resources and to apply the newly gained contents			
	identify scientific problems with concrete industrial use and to formulate solutions.			
Personal Competence				
Social Competence	After completion of this module participants should be at	ole to debate technical questions in small teams	to enhance the abili-	ty to take position to t
·	own opinions and increase their capacity for teamwork in			
Autonomy	After completion of this module participants will be able	to solve a technical problem in a team indep	endently by organizi	ng their workflow and
	present their results in aplenum.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	General Engineering Science (German program): Special	isation Chemical Engineering: Compulsory		
Curricula	General Engineering Science (German program): Special	isation Bioprocess Engineering: Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Speciali	sation Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Speciali			
	Biomedical Engineering: Specialisation Artificial Organs a			
	Biomedical Engineering: Specialisation Implants and End			
	Biomedical Engineering: Specialisation Medical Technology			
	Biomedical Engineering: Specialisation Management and			
	Technomathematics: Specialisation Engineering Science	·		



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

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

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



Module M0538: Heat and M	ass Transfer			
Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	4
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	 The students are capable of explaining qualitative a chemical reactors). They are capable of distinguish and characterize diffication. The students have the ability to explain the physical busing suitable mass transfer theories. They are able to depict the analogy between heat- an 	erent kinds of heat transfer mechanisms name basis for mass transfer in detail and to describ	ely heat conduction, h	neat transfer and therma
Skills	 The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses (In particular the course thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical problems. 			
Personal Competence Social Competence	The students are capable to work on subject-specific other students.	challenges in teams and to present the resul	ts orally in a reasona	ble manner to tutors and
Autonomy	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control their learning processes. 			
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisa	tion Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisa	tion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program): Specialisa	tion Energy and Enviromental Engineering: Co	ompulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Process Engineering: Compu	Isory	
	General Engineering Science (German program, 7 semester)	: Specialisation Bioprocess Engineering: Con	npulsory	
	General Engineering Science (German program, 7 semester)	: Specialisation Energy and Enviromental Eng	gineering: Compulsor	у
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: C	• •		
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program): Specialisat		mpulsory	
	General Engineering Science (English program): Specialisat			
	General Engineering Science (English program, 7 semester)		•	
	General Engineering Science (English program, 7 semester)			
	General Engineering Science (English program, 7 semester)		meering: Compulsor	у
	Technomathematics: Specialisation III. Engineering Science: Technomathematics: Core qualification: Elective Compulsory			
	Process Engineering: Core qualification: Compulsory			



Course L0101: Heat and Mass Transfer		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeattas	

Course L0102: Heat and Mass Transfer		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	A Hadharda	
	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	
	The students work on tasks in small groups and present their results in front of all students.	
Literature	H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas	



Module M0546: Thermal Se	eparation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L0118)		Lecture	3	3
Thermal Separation Processes (L0119)		Recitation Section (small)	2	1
Thermal Separation Processes (L0141)		Recitation Section (large)	1	1
Separation Processes (L1159)		Laboratory Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	The students can distinguish and describe different types of set. The students develop an understanding for the course of cor process, the possibilities of energy saving, and the selection of they have good knowledge of designing methods for separate.	ncentration during a separation proce f separation systems		
Skills	Using the gained knowledge the students can select a reason energy and material balances The students can use different graphical methods for the design they can select and design a basic type of thermal separat process The students are capable to obtain independently the needed They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the The students are able to discuss the theoretical background at The students are capable of linking their gained knowledge with the Other lectures such as thermodynamics, fluid mechanics and chemical	pring of a separation process and defon process for a given case based material properties from appropriate the experimental lab work. Indicate the description of the experimental wo content of other lectures and use it to	ine the amount of the on the advantages an sources (diagrams an rk with the teachers in	oretical stages required and disadvantages of the d tables)
Personal Competence Social Competence	The students can work technical assignments in small groups The students are able to carry out practical lab work in small	·		n them. They are able to
	discuss their results and to document them scientifically in a re		iolon of labor between	ir them. They are able to
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
Autonomy	The students are capable to obtain the needed information fro The students can proof the state of their knowledge with exam The students can proof the state of their knowledge with exam			ing process
Workload in Hours	Independent Study Time 82, Study Time in Lecture 98			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculations			
Assignment for the Following	General Engineering Science (German program): Specialisation Proc	ess Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisation Biop			
	General Engineering Science (German program): Specialisation Ene		ompulsory	
	General Engineering Science (German program, 7 semester): Specia	lisation Process Engineering: Compu	lsory	
	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (German program, 7 semester): Specia			у
	Bioprocess Engineering: Core qualification: Compulsory	0,		•
	Energy and Environmental Engineering: Core qualification: Compulsi	ory		
	General Engineering Science (English program): Specialisation Biop	•		
	General Engineering Science (English program): Specialisation Ener		mpulsory	
	General Engineering Science (English program): Specialisation Proc		,	
	General Engineering Science (English program, 7 semester): Special		sorv	
	General Engineering Science (English program, 7 semester): Special			
	General Engineering Science (English program, 7 semester): Special General Engineering Science (English program, 7 semester): Special			,
	Process Engineering: Core qualification: Compulsory	.oason Energy and Environmental Eng	g. Gompuisory	
	Frocess Engineering. Core quantication: Compulsory			



Course L0118: Thermal Separation	Processes
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattller: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie



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



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



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



Module M0892: Chemical R	eaction Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Chemical Reaction Engineering (Fundame	ntals) (L0204)	Lecture	2	2
Chemical Reaction Engineering (Fundame	ntals) (L0244)	Recitation Section (large)	2	2
Experimental Course Chemical Engineering	g (Fundamentals) (L0221)	Laboratory Course	2	2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules mathematics I-III, physical c	hemistry, technical thermodynamics I+II as w	ell as computational r	nethods for engineers.
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemical r	reaction engineering. They are able to point	out differences betwe	en thermodynamical and
	kinetical processes. The students have a strong ability to outlin	ne parts of isothermal and non-isothermal ide	al reactors and to des	scribe their properties.
Skills	After successful completion of the module, students are able to	0:		
	- apply different computational methods to dimension isothern	nal and non-isothermal ideal reactors,		
	- determine and compute stable operation points for these rea	ictors ,		
	- conduct experiments on a lab-scale pilot plants and docume	nt these according to scientific guidelines.		
Personal Competence				
Social Competence	After successful completition of the lab-course the students	have a strong ability to organize themselfes	s in small groups to	solve issues in chemical
	reaction engineering. The students can discuss their subject re	elated knowledge among each other and wit	h their teachers.	
Autonomy	The students are able to obtain further information and asse	ess their relevance autonomously. Students	can apply their know	rldege discretely to plan,
	prepare and conduct experiments.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	General Engineering Science (German program): Specialisati	ion Process Engineering: Compulsory		
Curricula	General Engineering Science (German program): Specialisati	ion Bioprocess Engineering: Compulsory		
	General Engineering Science (German program, 7 semester):	: Specialisation Process Engineering: Compu	ilsory	
	General Engineering Science (German program, 7 semester):	: Specialisation Bioprocess Engineering: Cor	npulsory	
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program): Specialisation	on Bioprocess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation	on Process Engineering: Compulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering: Compu	Isory	
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engineering: Con	pulsory	
	Process Engineering: Core qualification: Compulsory			

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



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

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

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

Literature

lecture notes Raimund Horn

skrint Frerich Keil

Books:

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



ırse L0244: Chemical Reaction E	Ingineering (Fundamentals)	
Hrs/wk	2	
СР		
Workload in Hours		
Lecturer Prof. Raimund Horn, Dr. Oliver Korup Language DE		
Language Cycle	WiSe	
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, iner	
	and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mas concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)	
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, line dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, 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 thermodynamic temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemic equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple 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 prexponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integrated integration of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rallimiting 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 reactor single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic stage 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 flor reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of cascade of tank reactors)	
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exotherm reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of t cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isotherm reactors, optimum temperature profile of a reactor)	
Literature	lecture notes Raimund Horn	
	skript Frerich Keil	
	Books:	
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH	
	G. Emig, E. Klemm, Technische Chemie, Springer	
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie	
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag	
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH	
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B	
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall	
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998	
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009	
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker	
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000	
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill	
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010	



Course L0221: Experimental Course Chemical Engineering (Fundamentals)		
Тур	Laboratory Course	
Hrs/wk	2	
CP		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Achim Bartsch	
Language	DE/EN	
Cycle		
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 M0539: Process an	d Plant Engineering I			
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Courses				
Title		Тур	Hrs/wk	СР
Process and Plant Engineering I (L0095)		Lecture	2	2
Process and Plant Engineering I (L0096)		Recitation Section (large)	1	2
Process and Plant Engineering I (L1214)	T	Recitation Section (small)	1	2
Module Responsible	Prof. Georg Fieg			
Admission Requirements	none			
Recommended Previous	unit operation of thermal an dmechanical separation processes			
Knowledge	chemical reactor eingineering			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	students can:			
	classify and formulate blobal balance equations of chemical process	ees		
	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 or	imponent 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				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following	General Engineering Science (German program): Specialisation Program			
Curricula	General Engineering Science (German program): Specialisation Bio			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Spec			
	General Engineering Science (German program, 7 semester): Speci Bioprocess Engineering: Core qualification: Compulsory	alisation Energy and Enviromental Eng	ineering: Elective Co	ompuisory
	General Engineering Science (English program): Specialisation Bio	aracess Engineering: Compulsory		
	General Engineering Science (English program): Specialisation Bio			
	General Engineering Science (English program, 7 semester): Specia	0 0 1 7	sorv	
	General Engineering Science (English program, 7 semester): Speci-			
	General Engineering Science (English program, 7 semester): Speci-			mpulsory
	Process Engineering: Core qualification: Compulsory	3,	<u> </u>	
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Course L0095: Process and Plant Engineering I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Course work	none
Lecturer	Prof. Georg Fieg
Language	DE
Cycle	SoSe
Content	1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression



Module Marida B. Sc.	General Engineering Science (English program)	Technische Universität Hamburg-Hau
	Data reconciliation and data validation 3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation	
Literature	C.D. Parrishi, I.D. Frie had Frad Chara 20(4000), C. 404 had Frad Chara 21(4000), C. 4670	
	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	
		0000
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt,	2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991	
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001	

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, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98

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

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

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

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



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



Module M0670: Particle Te	chnology and Solids Process Engineering			
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Courses		_		
Title		Тур	Hrs/wk	CP
Particle Technology I (L0434) Particle Technology I (L0435)		Lecture Recitation Section (small)	2	3 1
Particle Technology I (L0440)		Laboratory Course	2	2
Module Responsible	Prof. Stefan Heinrich	,		
Admission Requirements	None			
Recommended Previous	keine			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able to			
	 name and explain processes and unit-operations of solids 	process engineering,		
	characterize particles, particle distributions and to discuss	their bulk properties		
Skills	Students are able to			
				al a.k
	choose and design apparatuses and processes for solids asses solids with respect to their behavior in solids proces	•	ids properties of the pro	duci
	 document their work scientifically. 	sing steps		
	document their work scientifically.			
Personal Competence				
Social Competence	The students are able to discuss scientific topics orally with other	students or scientific personal and to de	evelop solutions for tech	nnical-scientific issues in
	a group.			
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	General Engineering Science (German program): Specialisation F			
Curricula	General Engineering Science (German program): Specialisation I		2	
	General Engineering Science (German program): Specialisation I			
	General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe		•	
	General Engineering Science (German program, 7 semester): Spire			,
	Bioprocess Engineering: Core qualification: Compulsory	scialisation Energy and Environmental El	ngmeening. Compaisor	1
	Energy and Environmental Engineering: Core qualification: Comp	ulsorv		
	General Engineering Science (English program): Specialisation B	·		
	General Engineering Science (English program): Specialisation E		Compulsory	
	General Engineering Science (English program): Specialisation F			
	General Engineering Science (English program, 7 semester): Spe		ulsory	
	General Engineering Science (English program, 7 semester): Spe		•	
	General Engineering Science (English program, 7 semester): Spe	cialisation Energy and Enviromental Er	ngineering: Compulsory	
	Process Engineering: Core qualification: Compulsory			



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

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

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



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ourses	
itle	Typ Hrs/wk CP
troduction to Management (L0880)	Lecture 4 4
roject Entrepreneurship (L0882)	Problem-based Learning 2 2
Module Responsible	
Admission Requirements	
Recommended Previous Knowledge	
Educational Objectives	
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from
	field of Management
	 explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and hu
	ressource management, information management, innovation management and marketing
	explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain the relevance of planning and decision making in Business.
	some basic methods from mathematical Finance
	state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry ou Entrepreneurship project in a team. In particular, they are able to
	A projugo Managament goals and structure them appropriately
	 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business 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 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 96, Study Time in Lecture 84
Credit points	
Examination	
Examination duration and scale	90 Minuten
Assignment for the Following	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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
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	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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 Bioprocess Engineering: Compulsory
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	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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 Enviromental 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 Aircraft Systems Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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 Enviromental 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 Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Compulsory
	General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): 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 Enviromental 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 Aircraft Systems Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science



Compulsory

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

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

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

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

Energy and Environmental Engineering: Core qualification: Compulsory

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory

Mechanical Engineering: Core qualification: Compulsory

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

Technomathematics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



Course L0880: Introduction to Management		
Typ Lecture		
Hrs/wk	4	
CP	4	
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang	
Lecturer	Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management 	
	Important definitions from Management,	
	 Developing Objectives for Business, and their relation to important Business functions 	
	 Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales 	
	Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management	
	Definitions as information, information systems, aspects of data security and strategic information systems	
	Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.	
	Relevance of marketing, B2B vs. B2C-Marketing	
	 different techniques from the field of marketing (e.g. scenario technique), pricing strategies 	
	important organizational structures	
	basics of human ressource management	
	Introduction to Business Planning and the steps of a planning process	
	Decision Analysis: Elements of decision problems and methods for solving decision problems	
	Selected Planning Tasks, e.g. Investment and Financial Decisions	
	Introduction to Accounting: Accounting, Balance-Sheets, Costing	
	Relevance of Controlling and selected Controlling methods	
	Important aspects of Entrepreneurship projects	
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008	
	Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003	
	Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.	
	Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.	
	Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.	
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.	
	Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.	
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.	

Course L0882: Project Entrepreneurship	
Тур	Problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl
Language	DE
Cycle	WiSe/SoSe
Content	In this project module, students work on an Entrepreneurship project. They are required to go through all relevant steps, from the first idea to the concept, using their knowledge from the corresponding lecture. Project work is carried out in teams with the support of a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.



Thesis

Module M-001: Bachelor Thesis		
Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Professoren der TUHH	
Admission Requirements	According to Occord Provided to 2004 (4)	
	According to General Regulations §24 (1):	
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.	
Recommended Previous		
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts).	
	theories, and methods).	
	On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and	
	establishing links with extended specialized expertise.	
	The students are able to outline the state of research on a selected issue in their subject area.	
Skills		
	 The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems. 	
	 With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and 	
	develop solutions.	
	The students can take up a critical position on the findings of their own research work from a specialized perspective.	
Personal Competence		
Social Competence	Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way.	
	The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they	
	can uphold their own assessments and viewpoints convincingly.	
Autonomy	The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame.	
	The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.	
	The students can apply the essential techniques of scientific work to research of their own.	
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0	
Credit points	12	
Examination	according to Subject Specific Regulations	
Examination duration and scale	laut FSPO	
Assignment for the Following	General Engineering Science (German program): Thesis: Compulsory	
Curricula		
	Civil- and Environmental Engineering: Thesis: Compulsory	
	Bioprocess Engineering: Thesis: Compulsory	
	Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory	
	Energy and Environmental Engineering: Thesis: Compulsory	
	General Engineering Science (English program): Thesis: Compulsory	
	General Engineering Science (English program, 7 semester): Thesis: Compulsory	
	Computational Science and Engineering: Thesis: Compulsory	
	Logistics and Mobility: Thesis: Compulsory	
	Mechanical Engineering: Thesis: Compulsory	
	Mechatronics: Thesis: Compulsory Navel Architecture: Thesis: Compulsory	
	Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory	
	Process Engineering: Thesis: Compulsory	