

## Module Manual

Master of Science

# Product Development, Materials and Production

Cohort: Winter Term 2017

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Module M1024: Methods of Integrated Product Development	
Module M1025: Fluidics	
Module M1155: Aircraft Cabin Systems	
Module M1174: Automation Technology and Systems	
Module M1183: Laser systems and methods of manufacturing design and analysis	
Module M0719: Biomaterials and Regenerative Medicine	
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#### Program description

#### Content

The consecutive master program "product development, materials and production" extends the education in engineering, mathematics and natural science of the bachelor studies. It provides systematic, scientific and autonomous problem solving capabilities needed in industry and research. The following phases of the product creation process are covered: strategic product planning; systematic and methodical development of products including concept development, design, material selection, simulation and testing; production including its planning and control, the use of modern production methods and high-performance materials. Students specialize in one of the three disciplines and acquire the ability to work at the interfaces of the disciplines. Students can choose from a wide range of electives and customize their studies very flexibly according to their individual needs and interests.

#### **Career prospects**

The consecutive Master course "product development, materials and production" prepares graduates for a wide range of job profiles in mechanical engineering. Graduates can work directly in their specialization area: product development, materials or production. They gain knowledge about numerous methods and about the work at interfaces between different disciplines that enables them to interdisciplinary work. Graduates may decide for direct entry into companies or to take up academic careers, e.g. Ph.D. studies, in universities or other research institutions. In companies they can take up jobs as specialists (e.g. designer, simulation engineer, production planner) or subsequently qualify for demanding management tasks in the technical area (e.g. project, group, or team leader; R&D or production manager or technical director). The program is designed to be universal and allows graduates to work in a variety of different industrial sectors (especially in mechanical engineering) and with different products.

#### Learning target

Graduates of the program are able to transfer the individually acquired specialized knowledge to new unknown topics, to grasp, to analyze and to scientifically solve complex problems of their discipline. They can find missing information and plan as well as execute theoretical and experimental studies. They are able to judge, evaluate and question scientific engineering results critically as well as making decisions based on this foundation and draw further conclusions. They are able to act methodically, to organize smaller projects, to select new technologies and scientific methods and to advance these further, if necessary.

Graduates can develop and document new ideas and solutions, independently or in team work. They are capable of presenting and arguing the results to professionals. They can estimate their own strengths and weaknesses as well as possible consequences of their actions. They are capable to familiarize themselves with complex tasks, define new tasks, develop the necessary knowledge for solving it and to systematically apply appropriate means.

#### **Product Development**

In the product development specialization, graduates learn to work systematically and methodically on challenging design tasks. They have a wide knowledge of new development methods, are able to select appropriate solution strategies and use these autonomously to develop new products. They are qualified to use the approaches of integrated product development, such as simulation or modern testing procedures, for example for the development of lightweight products. With their additional knowledge about modern highperformance materials and production processes graduates can design products on the cutting edge of technology, calculate and actively promote the development of products using modern methods.

#### Materials

Graduates of the discipline materials are able to work in the development, production and application of materials based on a natural scientific education. The material-oriented graduates can identify new fields of application and make the application-specific selection of the material under consideration of function, costs and quality.

#### Production

Graduates of the discipline production have in-depth knowledge of various production and manufacturing processes. They are qualified to evaluate those in the context of geometry creation, error control, cost effectiveness and humanization of work and are able to consider the interfaces of technology, organization and human, holistically.

#### Program structure

The course is designed modular and is based on the university-wide standardized course structure with uniform module sizes (multiples of six credit points (CP)). The mechanical engineering course combines the disciplines product development, materials and production and allows the deepening in one of these specializations. The students can broadly personalize their studies due to high number and variety of elective courses.

In the common core skills, students take the following modules:

- Finite element analysis and vibration theory (12 CP)
- Fundamental elective courses (catalog) (12 CP)
- Practical Course (6 CP)
- · Complementary courses business and management (catalog) (6 CP)
- Nontechnical elective complementary courses (catalog) (6 CP).

Students specialize by selecting one of the following areas, each covering 36 credit points:

- · Product development (product development methods, lightweight design)
- Production (production management, production technology)
- Materials (engineering materials).

Within each area of specialization three modules with six credit points are mandatory. An additional 18 credits can be chosen form a module catalog containing modules with a size of six credits. Instead, open modules can be attend to the maximum extent of twelve credit points, in which smaller specialized courses can be combined, individually.

Students write a master thesis and one additional scientific project work.

- Project work (12 CP)
- Master thesis (30 CP)



#### Core qualification

The students extend their knowledge and skills in advanced engineering subjects (e.g. vibration theory), in business and management as well as other non-technical topics. Students deepen their autonomous methodological and scientific problem solving skills in the field of product development, materials and production by attending a practical course and by writing a scientific project work.

dule M0523: Business 8	Management
Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
<b>Recommended Previous</b>	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge Skills	<ul> <li>Students are able to find their way around selected special areas of management within the scope of business management.</li> <li>Students are able to explain basic theories, categories, and models in selected special areas of business management.</li> <li>Students are able to interrelate technical and management knowledge.</li> </ul>
Personal Competence Social Competence Autonomy	• Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	
Credit points	6

Courses

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



Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The Nontechnical Academic Programms (NTA)
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance
	management, collaboration and professional and personnel management competences. The department implements these training objectives
	teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can be
	by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two di
	catalogues for nontechnical complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic progra follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also pro-
	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. I
	of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in o
	encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of the second
	studies.
	Teaching and Learning Associate
	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 interdiscip
	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 studies, mig
	studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's cours
	have the opportunity to learn about business management and start-ups in a goal-oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented commun
	skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	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 re
	in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical le
	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 Back
	and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	explain specialized areas in context of the relevant non-technical disciplines,
	outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,
	<ul> <li>different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradiams, models, instruments, methods and forms of representation in the specialist disciplines are specialisted with the specialisted wit</li></ul>
	<ul> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the spec sciences are subject to individual and socio-cultural interpretation and historicity,</li> </ul>
	<ul> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul>
<b></b>	
Skills	Professional Competence (Skills)
	In selected sub-areas students can
	apply basic and specific methods of the said scientific disciplines,
	<ul> <li>apply base and specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> </ul>
	<ul> <li>to handle simple and advanced questions in aforementioned scientific disciplines in a successful manner,</li> </ul>
	• justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship
	subject.
Personal Competence	
Social Competence	Personal Competences (Social Skills)
	Students will be able
	<ul> <li>to learn to collaborate in different manner,</li> <li>to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> </ul>

[6]



Autonomy	<ul> <li>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),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul> Personal Competences (Self-reliance) Students are able in selected areas <ul> <li>to reflect on their own profession and professionalism in the context of real-life fields of application</li> <li>to organize themselves and their own learning processes</li> <li>to reflect and decide questions in front of a broad education background</li> <li>to communicate a nontechnical item in a competent way in writen form or verbaly</li> <li>to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li></ul>
Workload in Hours	Depends on choice of courses
Credit points	6
0	
Courses	

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



Module M0603: Nonlinear S	Structural Analysis				
0					
Courses					
Title		Тур	Hrs/wk	CP	
Nonlinear Structural Analysis (L0277)			3	4	
Nonlinear Structural Analysis (L0279)		Recitation Section (small)	I	2	
Module Responsible	Prof. Alexander Düster				
Admission Requirements	None				
Recommended Previous	Mathematics I, II, III, Mechanics I, II, III, IV				
Knowledge	Differential Equations 2 (Partial Differential Equations)				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results			
Professional Competence					
Knowledge	Students are able to				
	+ give an overview of the different nonlinear phenomena in str	uctural mechanics.			
	+ explain the mechanical background of nonlinear phenomena	a in structural mechanics.			
	+ to specify problems of nonlinear structural analysis, to identif	y them in a given situation and to explain the	ir mathematical and r	nechanical background	
Skills	Students are able to				
okino -	+ model nonlinear structural problems.				
	+ select for a given nonlinear structural problem a suitable computational procedure.				
	+ apply finite element procedures for nonlinear structural analysis.				
	+ critically verify and judge results of nonlinear finite elements.				
	+ to transfer their knowledge of nonlinear solution procedures	to new problems.			
Personal Competence					
Social Competence	Students are able to				
Social Competence	+ solve problems in heterogeneous groups and to document th	a corresponding results			
	+ share new knowledge with group members.	le corresponding results.			
	i share new knowledge with group memorie.				
Autonomy	Students are able to				
	+ assess their knowledge by means of exercises and E-Learni	ng.			
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	Civil Engineering: Specialisation Structural Engineering: Elect	ive Compulsory			
Curricula	International Management and Engineering: Specialisation II.	Civil Engineering: Elective Compulsory			
	Materials Science: Specialisation Modeling: Elective Compulse	•			
	Mechatronics: Specialisation System Design: Elective Compul				
	Product Development, Materials and Production: Core qualific	ation: Elective Compulsory			
	Naval Architecture and Ocean Engineering: Core qualification	Elective Compulsory			
	Ship and Offshore Technology: Core qualification: Elective Co	mpulsory			
	Theoretical Mechanical Engineering: Core qualification: Election	ve Compulsory			
	Theoretical Mechanical Engineering: Technical Complementa	ry Course: Elective Compulsory			

Course L0277: Nonlinear Structural	Analysis
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	DE/EN
Cycle	WiSe
Content	1. Introduction
	2. Nonlinear phenomena
	3. Mathematical preliminaries
	4. Basic equations of continuum mechanics
	5. Spatial discretization with finite elements
	6. Solution of nonlinear systems of equations
	7. Solution of elastoplastic problems
	8. Stability problems
	9. Contact problems
Literature	[1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014.
	[2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008.
	[3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001.
	[4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, 2008.



Course L0279: Nonlinear Structural	Course L0279: Nonlinear 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. Alexander Düster		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



ineering			
	Тур	Hrs/wk	CP
	Lecture	3	5
	Recitation Section (large)	1	1
rof. Gerhard Schmitz			
one			
echnical Thermodynamics I, II, Fluid Dynamics, Heat Trans	sfer		
fter taking part successfully, students have reached the foll	owing learning results		
tudents know the different energy conversion stages and	the difference between efficiency and annua	l efficiency. They have	increased knowledge in
Students know the different energy conversion stages and the difference between efficiency and annual efficiency. They have increased knowledge in heat and mass transfer, especially in regard to buildings and mobile applications. They are familiar with German energy saving code and other technical structures.			
elevant rules. They know to differ different heating systems	in the domestic and industrial area and how	to control such heating	g systems. They are abl
to model a furnace and to calculate the transient temperatures in a furnace. They have the basic knowledge of emission formations in the flames of small			
urners and how to conduct the flue gases into the atmosph	nere. They are able to model thermodynamic s	systems with object orie	ented languages.
tudents are able to calculate the heating demand for diffe	erent heating systems and to choose the suit	able components. The	y are able to calculate
peline network and have the ability to perform simple pl	anning tasks, regarding solar energy. They	can write Modelica pro	ograms and can transf
esearch knowledge into practice. They are able to perform	scientific work in the field of thermal engineeri	ng.	
he students are able to discuss in small groups and develo	op an approach.		
tudents are able to define independently tasks, to get new	knowledge from existing knowledge as well a	s to find ways to use th	e knowledge in practice
dependent Study Time 124, Study Time in Lecture 56			
/ritten exam			
0 min			
ioprocess Engineering: Specialisation A - General Bioproc	ess Engineering: Elective Compulsory		
		ective Compulsory	
•	2		
	Systems: Elective Compulsory		
	fter taking part successfully, students have reached the foll tudents know the different energy conversion stages and eat and mass transfer, especially in regard to buildings an elevant rules. They know to differ different heating systems to model a furnace and to calculate the transient temperatur urners and how to conduct the flue gases into the atmosph tudents are able to calculate the heating demand for diffe ipeline network and have the ability to perform simple pl esearch knowledge into practice. They are able to perform tudents are able to discuss in small groups and develor tudents are able to define independently tasks, to get new adependent Study Time 124, Study Time in Lecture 56 ///itten exam 0 min ioprocess Engineering: Specialisation A - General Bioproc nergy and Environmental Engineering: Specialisation Ene nergy Systems: Specialisation Marine Engineering: Electiv ternational Management and Engineering: Specialisation roduct Development, Materials and Production: Core quali enewable Energies: Core qualification: Compulsory heoretical Mechanical Engineering: Specialisation Energy heoretical Mechanical Engineering: Technical Complement	rof. Gerhard Schmitz ione echnical Thermodynamics I, II, Fluid Dynamics, Heat Transfer fter taking part successfully, students have reached the following learning results tudents know the different energy conversion stages and the difference between efficiency and annua eat and mass transfer, especially in regard to buildings and mobile applications. They are familiar with C slevant rules. They know to differ different heating systems in the domestic and industrial area and how model a furnace and to calculate the transient temperatures in a furnace. They have the basic knowled urners and how to conduct the flue gases into the atmosphere. They are able to model thermodynamic s tudents are able to calculate the heating demand for different heating systems and to choose the suit ipeline network and have the ability to perform simple planning tasks, regarding solar energy. They esearch knowledge into practice. They are able to perform scientific work in the field of thermal engineer tudents are able to discuss in small groups and develop an approach. tudents are able to define independently tasks, to get new knowledge from existing knowledge as well a idependent Study Time 124, Study Time in Lecture 56 ////////////////////////////////////	rof. Gerhard Schmitz one echnical Thermodynamics I, II, Fluid Dynamics, Heat Transfer fiter taking part successfully, students have reached the following learning results tudents know the different energy conversion stages and the difference between efficiency and annual efficiency. They have eat and mass transfer, especially in regard to buildings and mobile applications. They are familiar with German energy saving; elevant rules. They know to differ different heating systems in the domestic and industrial area and how to control such heating wnodel a turnes and to calculate the transient temperatures in a turnace. They have the basic knowledge of emission formatic turners and how to conduct the flue gases into the atmosphere. They are able to model thermodynamic systems with object orie tudents are able to calculate the heating demand for different heating systems and to choose the suitable components. The ippline network and have the ability to perform simple planning tasks, regarding solar energy. They can write Modelica pro search knowledge into practice. They are able to perform scientific work in the field of thermal engineering.  tudents are able to discuss in small groups and develop an approach. tudents are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use th ridependent Study Time 124, Study Time in Lecture 56  fiften exam 0 min ioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory nergy Systems: Specialisation Energy Systems: Compulsory nergy Systems: Specialisation A - General Bioprocess Engineering: Elective Compulsory nergy Systems: Specialisation Energy Systems: Compulsory ternational Management and Engineering: Elective Compulsory ternational Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory inergy Systems: Specialisation Compulsory ternational Management and Engineering: Specialisation II. Energy Systems: Elective Compulsory inergeneering:

Course L0023: Thermal Engineering	
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	1. Introduction
	<ol> <li>Fundamentals of Thermal Engineering 2.1 Heat Conduction 2.2 Convection 2.3 Radiation 2.4 Heat transition 2.5 Combustion parameters 2.6 Electrical heating 2.7 Water vapor transport</li> <li>Heating Systems 3.1 Warm water heating systems 3.2 Warm water supply 3.3 piping calculation 3.4 boilers, heat pumps, solar collectors 3.5 Air heating systems 3.6 radiative heating systems</li> <li>Thermal traetment systems 4.1 Industrial furnaces 4.2 Melting furnaces 4.3 Drying plants 4.4 Emission control 4.5 Chimney calculation 4.6 Energy measuring</li> <li>Laws and standards 5.1 Buildings 5.2 Industrial plants</li> </ol>
Literature	<ul> <li>Schmitz, G.: Klimaanlagen, Skript zur Vorlesung</li> <li>VDI Wärmeatlas, 11. Auflage, Springer Verlag, Düsseldorf 2013</li> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, Vieweg+Teubner Verlag, Wiesbaden 2009</li> <li>Recknagel, H.; Sprenger, E.; Schrammek, ER.: Taschenbuch für Heizung- und Klimatechnik 2013/2014, 76. Auflage, Deutscher Industrieverlag, 2013</li> </ul>



Course L0024: Thermal Engineering	ourse L0024: Thermal Engineering		
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		



Module M0751: Vibration T	heory			
Courses				
Title		Тур	Hrs/wk	CP
Vibration Theory (L0701)		Lecture	4	6
Module Responsible	Prof. Norbert Hoffmann			-
Admission Requirements	None			
Recommended Previous				
Knowledge	Calculus			
Rhomeage	Linear Algebra			
	Engineering Mechanics			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	Students are able to denote terms and concepts	of Vibration Theory and develop them further.		
Skills	Students are able to denote methods of Vibration	Theory and develop them further.		
Personal Competence				
Social Competence	Students can reach working results also in group	IS.		
Autonomy	Students are able to approach individually research tasks in Vibration Theory.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 Hours			
Assignment for the Following	Energy Systems: Core qualification: Elective Con	npulsory		
Curricula	Computational Science and Engineering: Specia	lisation Scientific Computing: Elective Compulsory		
	International Management and Engineering: Spe	ecialisation II. Mechatronics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial	Organs and Regenerative Medicine: Elective Compu	lsory	
	Biomedical Engineering: Specialisation Implants	and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical	Technology and Control Theory: Elective Compulsory	у	
	Biomedical Engineering: Specialisation Manager	ment and Business Administration: Elective Compulse	ory	
	Product Development, Materials and Production:	Core qualification: Compulsory		
	Naval Architecture and Ocean Engineering: Core	e qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualif	fication: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical C	Complementary Course: Elective Compulsory		

Course L0701: Vibration Theory	
Тур	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Norbert Hoffmann
Language	DE/EN
Cycle	WiSe
Content	Linear and Nonlinear Single and Multiple Degree of Freedom Oscillations and Waves.
Literature	K. Magnus, K. Popp, W. Sextro: Schwingungen. Physikalische Grundlagen und mathematische Behandlung von Schwingungen. Springer Verlag, 2013.



Module M0808: Finite Elem	ents Methods			
Courses				
Title		Тур	Hrs/wk	CP
Finite Element Methods (L0291)		Lecture	2	3
Finite Element Methods (L0804)		Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous	Mechanics I (Statics, Mechanics of Materials) and Mechanics	II (Hydrostatics, Kinematics, Dynamics)		
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	The laking part succession, succession have reached the lone			
Knowledge	The students possess an in-depth knowledge regarding the	derivation of the finite element method and	are able to give an o	verview of the theoretic
Kitowieuge	and methodical basis of the method.	derivation of the linite element method and	are able to give all o	
Skills	The students are capable to handle engineering problems b	y formulating suitable finite elements, asser	nbling the correspond	ling system matrices, a
	solving the resulting system of equations.			
Personal Competence				
Social Competence	-			
Autonomy	The students are able to independently solve challenging co	mputational problems and develop own finit	e element routines. P	roblems can be identif
	and the results are critically scrutinized.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Civil Engineering: Core qualification: Compulsory			
Curricula	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems			
	Aircraft Systems Engineering: Specialisation Air Transportatio			
	Computational Science and Engineering: Specialisation Scie			
	International Management and Engineering: Specialisation II			
	International Management and Engineering: Specialisation II	. Product Development and Production: Elec	tive Compulsory	
	Mechatronics: Core qualification: Compulsory			
	Biomedical Engineering: Specialisation Implants and Endopr			
	Biomedical Engineering: Specialisation Management and Bu			
	Biomedical Engineering: Specialisation Medical Technology			
	Biomedical Engineering: Specialisation Artificial Organs and	•	у	
	Product Development, Materials and Production: Core qualifi			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Core qualification: Corr	pulsorv		



Course L0291: Finite Element Methods		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	- General overview on modern engineering	
	- Displacement method	
	- Hybrid formulation	
	- Isoparametric elements	
	- Numerical integration	
	- Solving systems of equations (statics, dynamics)	
	- Eigenvalue problems	
	- Non-linear systems	
	- Applications	
	- Programming of elements (Matlab, hands-on sessions)	
	- Applications	
Literature	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin	

Course L0804: Finite Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0846: Control Sys	stems Theory and Design			
Courses				
Title		Тур	Hrs/wk	CP
Control Systems Theory and Design (L06	56)	Lecture	2	4
Control Systems Theory and Design (L06		Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Introduction to Control Systems			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	The laking part succession, success have reached			
Knowledge	<ul> <li>Students can explain how linear dynamic syst or external excitation as trajectories in state sp</li> </ul>	tems are represented as state space models; they ca bace	n interpret the system	response to initial sta
		llability and observability, and their relationship to sta	ite feedback and state	e estimation, respective
	<ul> <li>They can explain the significance of a minimal</li> </ul>			
		ack and how it can be used to achieve tracking and di	sturbance rejection	
	<ul> <li>They can extend all of the above to multi-input</li> </ul>			
	They can explain the z-transform and its relation	onship with the Laplace Transform		
	They can explain state space models and tran	sfer function models of discrete-time systems		
	They can explain the experimental identification	on of ARX models of dynamic systems, and how the i	dentification problem	can be solved by solv
	a normal equation			
	They can explain how a state space model can	n be constructed from a discrete-time impulse respon	se	
Skills				
Skills	Students can transform transfer function mode	Is into state space models and vice versa		
	They can assess controllability and observabil	lity and construct minimal realisations		
	They can design LQG controllers for multivaria	able plants		
	They can carry out a controller design both ir	n continuous-time and discrete-time domain, and dec	ide which is approp	riate for a given sampl
	rate			
	They can identify transfer function models and	I state space models of dynamic systems from experir	nental data	
	They can carry out all these tasks using stands	ard software tools (Matlab Control Toolbox, System Id	entification Toolbox,	Simulink)
Personal Competence				
Social Competence	Students can work in small groups on specific probler	ms to arrive at joint solutions.		
Autonomy	Students can obtain information from provided sour	rces (lecture notes, software documentation, experi	ment guides) and us	se it when solving giv
	problems.			
	They can assess their knowledge in weekly on-line te	ests and thereby control their learning progress.		
Workload in Hours	Independent Study Time 124 Study Time in Lecture 5	56		
Credit points	Independent Study Time 124, Study Time in Lecture 5			
Examination	Written exam			
Examination Examination duration and scale	120 min			
Assignment for the Following	Computer Science: Specialisation Intelligence Engine Electrical Engineering: Core gualification: Compulsor			
Curricula	Energy Systems: Core qualification: Elective Compulsor	,		
	Aircraft Systems Engineering: Specialisation Aircraft S	•		
	Computational Science and Engineering: Specialisation		nulson	
	International Management and Engineering: Specialisati			
	International Management and Engineering: Specialis			
	Mechanical Engineering and Management: Specialis			
	Mechatronics: Core qualification: Compulsory	Callen Mediateriles. Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Orga	ans and Regenerative Medicine: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants and	• • • •		
	Biomedical Engineering: Specialisation Impants and			
	Biomedical Engineering: Specialisation Medical rech			
	openation wanagement	doinedo / doinindi dilori. Erective Oompulsory		
	Product Development, Materials and Production: Core	e qualification: Elective Compulsory		



Course L0656: Control Systems Theory and Design		
Typ	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	EN	
Cycle	WiSe	
Content	State space methods (single-input single-output)	
	State space models and transfer functions, state feedback	
	Coordinate basis, similarity transformations	
	Solutions of state equations, matrix exponentials, Caley-Hamilton Theorem	
	Controllability and pole placement	
	State estimation, observability, Kalman decomposition	
	Observer-based state feedback control, reference tracking	
	Transmission zeros	
	Optimal pole placement, symmetric root locus	
	Multi-input multi-output systems	
	Transfer function matrices, state space models of multivariable systems, Gilbert realization	
	Poles and zeros of multivariable systems, minimal realization	
	Closed-loop stability	
	Pole placement for multivariable systems, LQR design, Kalman filter	
	Digital Control	
	Discrete-time systems: difference equations and z-transform	
	Discrete-time state space models, sampled data systems, poles and zeros	
	Frequency response of sampled data systems, choice of sampling rate	
	System identification and model order reduction	
	Least squares estimation, ARX models, persistent excitation	
	Identification of state space models, subspace identification	
	Balanced realization and model order reduction	
	Case study	
	Modelling and multivariable control of a process evaporator using Matlab and Simulink	
	Software tools	
	• Matlab/Simulink	
L November		
Literature	Werner, H., Lecture Notes "Control Systems Theory and Design"	
	T. Kailath "Linear Systems", Prentice Hall, 1980	
	K.J. Astrom, B. Wittenmark "Computer Controlled Systems" Prentice Hall, 1997	
	L. Ljung "System Identification - Theory for the User", Prentice Hall, 1999	

Course L0657: Control Systems The	Course L0657: Control Systems Theory and Design	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

П



Module M1150: Continuum	Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
Continuum Mechanics (L1533)		Lecture	2	3
Continuum Mechanics Exercise (L1534)		Recitation Section (small)	2	3
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	None			
Recommended Previous	Mechanics I			
Knowledge				
	Mechanics II			
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence				
Knowledge				
	The students can explain the fundamental concepts to calculate the med	chanical behavior of materials.		
Skills	The students can set up balance laws and apply basics of deformation t	heory to specific aspects, both in appl	lied contexts as in re	esearch contexts.
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to develop	ideas further.		
p	· · · · · · · · · · · · · · · · · · ·			
Autonomy	The students are able to assess their own strengths and weaknesses a	nd to define tasks themselves. They c	an solve exercises	in the area of continuum
	mechanics on their own.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Computational Science and Engineering: Specialisation Scientific Com	outing: Elective Compulsory		
Curricula	Materials Science: Specialisation Modeling: Elective Compulsory			
	Mechanical Engineering and Management: Specialisation Materials: El	ective Compulsory		
	Mechatronics: Technical Complementary Course: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regeneration	ive Medicine: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants and Endoprostheses:	Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and Contro	ol Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Business Ad			
	Product Development, Materials and Production: Core qualification: Ele			
	Theoretical Mechanical Engineering: Technical Complementary Course	: Elective Compulsory		

Course L1533: Continuum Mechanics		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Swantje Bargmann	
Language	DE/EN	
Cycle	WiSe	
Content	<ul> <li>kinematics of undeformed and deformed bodies</li> <li>balance equations (balance of mass, balance of energy,)</li> <li>stress states</li> <li>material modelling</li> </ul>	
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer	



Course L1534: Continuum Mechanie	cs Exercise
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Swantje Bargmann
Language	DE/EN
Cycle	WiSe
Content	<ul> <li>kinematics of undeformed and deformed bodies</li> <li>balance equations (balance of mass, balance of energy,)</li> <li>stress states</li> <li>material modelling</li> </ul>
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer



Module M1151: Material Mo	odeling			
Courses				
Title		Тур	Hrs/wk	CP
Material Modeling (L1535)		Lecture	2	3
Material Modeling (L1536)	I	Recitation Section (small)	2	3
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	None			
Recommended Previous	mechanics I			
Knowledge	mechanics II			
	continuum mechanics			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The students can explain the fundamentals of mult	tidimensional consitutive material laws		
Skills	The students can implement their own material law	ws in finite element codes. In particular, the students o	can apply their knowled	ge to various problems
	material science and evaluate the corresponding r	material models.		
Personal Competence				
Social Competence	The students are able to develop solutions, to pres	sent them to specialists and to develop ideas further.		
Autonomy	The students are able to assess their own strength	ns and weaknesses and to define tasks themselves. T	hey can solve exercises	in the area of continuu
	mechanics on their own.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Computational Science and Engineering: Speciali	sation Scientific Computing: Elective Compulsory		
Curricula	Materials Science: Specialisation Modeling: Election			
	Mechanical Engineering and Management: Specia			
	Biomedical Engineering: Specialisation Artificial O	Organs and Regenerative Medicine: Elective Compulso	ory	
	Biomedical Engineering: Specialisation Implants a	and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical T	echnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Managem	ent and Business Administration: Elective Compulsor	у	
	Product Development, Materials and Production: C	Core qualification: Elective Compulsory		

Course L1535: Material Modeling	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Swantje Bargmann
Language	DE/EN
Cycle	WiSe
Content	<ul> <li>fundamentals of finite element methods</li> <li>fundamentals of material modeling</li> <li>introduction to numerical implementation of material laws</li> <li>overview of modelling of different classes of materials</li> <li>combination of macroscopic quantities to material microstructure</li> </ul>
Literature	D. Raabe: Computational Materials Science, The Simulation of Materials, Microstructures and Properties, Wiley-Vch J. Bonet, R.D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge G. Gottstein., Physical Foundations of Materials Science, Springer



Course L1536: Material Modeling	
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Swantje Bargmann
Language	DE/EN
Cycle	WiSe
Content	
	<ul> <li>fundamentals of finite element methods</li> <li>fundamentals of material modeling</li> <li>introduction to numerical implementation of material laws</li> <li>overview of modelling of different classes of materials</li> <li>combination of macroscopic quantities to material microstructure</li> </ul>
Literature	<ul> <li>D. Raabe: Computational Materials Science, The Simulation of Materials, Microstructures and Properties, Wiley-Vch</li> <li>J. Bonet, R.D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge</li> <li>G. Gottstein., Physical Foundations of Materials Science, Springer</li> </ul>



Module M1173: Applied Sta	atistics			
Courses				
Title		Тур	Hrs/wk	CP
Applied Statistics (L1584)		Lecture	2	3
Applied Statistics (L1586)		Problem-based Learning	2	2
Applied Statistics (L1585)		Recitation Section (small)	1	- 1
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	Basic knowledge of statistical methods			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students can explain the statistical methods and the conditions of their use.			
Skills	Students are able to use the statistics program to solve statistics problems and to interpret and depict the results			
Personal Competence				
Social Competence	Team Work, joined presentation of results			
A. (				
Autonomy	To understand and interpret the question and solve			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, 28 questions			
Assignment for the Following	Mechanical Engineering and Management: Specialisat	on Management: Elective Compulsory		
Curricula	Mechatronics: Specialisation System Design: Elective C	Compulsory		
	Mechatronics: Specialisation Intelligent Systems and Re	botics: Elective Compulsory		
	Biomedical Engineering: Core qualification: Compulsor	у		
	Product Development, Materials and Production: Core of	qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Bio	- and Medical Technology: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Comple	ementary Course: Elective Compulsory		

Course L1584: Applied Statistics	
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/EN
Cycle	WiSe
Content	The goal is to introduce students to the basic statistical methods and their application to simple problems. The topics include:
	Chi square test
	Simple regression and correlation
	Multiple regression and correlation
	One way analysis of variance
	Two way analysis of variance
	Discriminant analysis
	Analysis of categorial data
	Chossing the appropriate statistical method
	Determining critical sample sizes
Literature	Applied Regression Analysis and Multivariable Methods, 3rd Edition, David G. Kleinbaum Emory University, Lawrence L. Kupper University of North
	Carolina at Chapel Hill, Keith E. Muller University of North Carolina at Chapel Hill, Azhar Nizam Emory University, Published by Duxbury Press, CB ©
	1998, ISBN/ISSN: 0-534-20910-6



Course L1586: Applied Statistics	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
	The students receive a problem task, which they have to solve in small groups (n=5). They do have to collect their own data and work with them. The results have to be presented in an executive summary at the end of the course.
Literature	Selbst zu finden

Course L1585: Applied Statistics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
Content	The different statistical tests are applied for the solution of realistic problems using actual data sets and the most common used commercial statistical software package (SPSS).
Literature	Student Solutions Manual for Kleinbaum/Kupper/Muller/Nizam's Applied Regression Analysis and Multivariable Methods, 3rd Edition, David G. Kleinbaum Emory University Lawrence L. Kupper University of North Carolina at Chapel Hill, Keith E. Muller University of North Carolina at Chapel Hill, Azhar Nizam Emory University, Published by Duxbury Press, Paperbound © 1998, ISBN/ISSN: 0-534-20913-0

Courses					
		<b>T</b>	Here fords	0.5	
Title		Тур	Hrs/wk 2	<b>CP</b> 3	
Flexible Multibody Systems (L1632) Optimization of dynamical systems (L1633	3)	Lecture	2	3	
Module Responsible	Prof. Robert Seifried	2001010	-	5	
Admission Requirements	None				
Recommended Previous					
Knowledge	Mathematics I, II, III				
Ũ	Mechanics I, II, III, IV				
	<ul> <li>Simulation of dynamical Systems</li> </ul>				
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results			
Professional Competence					
Knowledge	Students demonstrate basic knowledge and understanding of	modeling, simulation and analysis	of complex rigid and flexible	multibody systems	
	methods for optimizing dynamic systems after successful comp	etion of the module.			
Skills	Students are able				
	+ to think holistically				
	+ to independently, securly and critically analyze and optimize	pasic problems of the dynamics of ri	gid and flexible multibody sys	tems	
	+ to describe dynamics problems mathematically	+ to describe dynamics problems mathematically			
	+ to optimize dynamics problems				
Personal Competence					
Social Competence	Students are able to				
oodal oompeterioo					
	+ solve problems in heterogeneous groups and to document the corresponding results.				
Autonomy	Students are able to				
···· ,					
	+ assess their knowledge by means of exercises.				
	+ acquaint themselves with the necessary knowledge to solve	esearch oriented tasks.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Oral exam				
Examination duration and scale	30 min				
Assignment for the Following	Energy Systems: Core qualification: Elective Compulsory				
Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: I				
	Mechatronics: Specialisation System Design: Elective Compuls	•			
	Mechatronics: Specialisation Intelligent Systems and Robotics:				
	Product Development, Materials and Production: Core qualifica				
	Theoretical Mechanical Engineering: Core qualification: Electiv Theoretical Mechanical Engineering: Technical Complementar				
	Theoretical Mechanical Engineering: Technical Complementar Theoretical Mechanical Engineering: Technical Complementar				

Courses L 1620, Elevible Multiberty C	
Course L1632: Flexible Multibody S	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	<ol> <li>Basics of Multibody Systems</li> <li>Basics of Continuum Mechanics</li> <li>Linear finite element modelles and modell reduction</li> <li>Nonlinear finite element Modelles: absolute nodal coordinate formulation</li> <li>Kinematics of an elastic body</li> <li>Kinetics of an elastic body</li> <li>System assembly</li> </ol>
Literature	Schwertassek, R. und Wallrapp, O.: Dynamik flexibler Mehrkörpersysteme. Braunschweig, Vieweg, 1999. Seifried, R.: Dynamics of Underactuated Multibody Systems, Springer, 2014. Shabana, A.A.: Dynamics of Multibody Systems. Cambridge Univ. Press, Cambridge, 2004, 3. Auflage.



Course L1633: Optimization of dyna	mical systems
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried, Dr. Alexander Held
Language	DE
Cycle	WiSe
Content	<ol> <li>Formulation and classification of optimization problems</li> <li>Scalar Optimization</li> <li>Sensitivity Analysis</li> <li>Unconstrained Parameter Optimization</li> <li>Constrained Parameter Optimization</li> <li>Stochastic optimization</li> <li>Stochastic optimization</li> <li>Multicriteria Optimization</li> <li>Topology Optimization</li> </ol>
Literature	Bestle, D.: Analyse und Optimierung von Mehrkörpersystemen. Springer, Berlin, 1994. Nocedal, J., Wright, S.J.: Numerical Optimization. New York: Springer, 2006.



Module M0604: High-Order	FEM			
Courses				
		Tree	Unakuk	CP
Title		Typ Lecture	Hrs/wk 3	4
High-Order FEM (L0280) High-Order FEM (L0281)		Recitation Section (large)	3	4
Module Responsible	Prof. Alexander Düster	recitation occition (hargo)	·	L
Admission Requirements	None			
Recommended Previous	Mathematics I, II, III, Mechanics I, II, III, IV			
Knowledge	Differential Equations 2 (Partial Differential Equations)			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students are able to			
	+ give an overview of the different (h, p, hp) finite element proceed	ures.		
	+ explain high-order finite element procedures.			
	+ specify problems of finite element procedures, to identify them	in a given situation and to explain their ma	thematical and mech	anical background.
Skills	Students are able to			
	+ apply high-order finite elements to problems of structural mechanics.			
	+ select for a given problem of structural mechanics a suitable finite element procedure.			
	+ critically judge results of high-order finite elements.			
	+ transfer their knowledge of high-order finite elements to new pr	oblems.		
Personal Competence				
Social Competence	Students are able to			
,	+ solve problems in heterogeneous groups and to document the	corresponding results.		
Autonomy	Students are able to			
	+ assess their knowledge by means of exercises and E-Learning			
	+ acquaint themselves with the necessary knowledge to solve re	search onented tasks.		
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	Energy Systems: Core qualification: Elective Compulsory			
Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory			
	Materials Science: Specialisation Modeling: Elective Compulsory			
	Mechanical Engineering and Management: Specialisation Produ	ict Development and Production: Elective	Compulsory	
	Mechatronics: Technical Complementary Course: Elective Comp	•		
	Product Development, Materials and Production: Core qualificati			
	Naval Architecture and Ocean Engineering: Core qualification: E			
	Theoretical Mechanical Engineering: Technical Complementary			
	Theoretical Mechanical Engineering: Core qualification: Elective	Compulsory		

Course L0280: High-Order FEM	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	EN
Cycle	SoSe
Content	1. Introduction
	2. Motivation
	3. Hierarchic shape functions
	4. Mapping functions
	5. Computation of element matrices, assembly, constraint enforcement and solution
	6. Convergence characteristics
	7. Mechanical models and finite elements for thin-walled structures
	8. Computation of thin-walled structures
	9. Error estimation and hp-adaptivity
	10. High-order fictitious domain methods
Literature	[1] Alexander Düster, High-Order FEM, Lecture Notes, Technische Universität Hamburg-Harburg, 164 pages, 2014
	[2] Barna Szabo, Ivo Babuska, Introduction to Finite Element Analysis – Formulation, Verification and Validation, John Wiley & Sons, 2011



Course L0281: High-Order FEM	Course L0281: High-Order FEM		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Alexander Düster		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0805: Technical A	Acoustics I (Acoustic Waves, Noise Protect	ction, Psycho Acoustics )		
Courses				
Title		Тур	Hrs/wk	CP
	oise Protection, Psycho Acoustics ) (L0516)	Lecture	2	3
	oise Protection, Psycho Acoustics ) (L0518)	Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous	Mechanics I (Statics, Mechanics of Materials) and Mecha	anics II (Hydrostatics, Kinematics, Dynamics)		
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge in acous	tics regarding acoustic waves, noise protection, a	and psycho acoustics	and are able to give a
-	overview of the corresponding theoretical and methodica	al basis.		-
Skills	The students are capable to handle engineering problem	ns in acoustics by theory-based application of the	demanding methodo	logies and measureme
	procedures treated within the module.			
Personal Competence				
Social Competence				
Autonomy	The students are able to independently solve challengi	ng acoustical problems in the areas treated withi	n the module. Possik	ble conflicting issues ar
	limitations can be identified and the results are critically	scrutinized.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Energy Systems: Core qualification: Elective Compulsor	y		
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems	ems: Elective Compulsory		
	International Management and Engineering: Specialisat	ion II. Aviation Systems: Elective Compulsory		
	Mechatronics: Specialisation System Design: Elective Co	ompulsory		
	Product Development, Materials and Production: Core q	ualification: Elective Compulsory		
	Technomathematics: Core qualification: Elective Compu	Isory		
	Technomathematics: Specialisation III. Engineering Scie	nce: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complete	mentary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complete			
	Theoretical Mechanical Engineering: Specialisation Pro-	duct Development and Production: Elective Compu	ulsory	

Course L0516: Technical Acoustics	I (Acoustic Waves, Noise Protection, Psycho Acoustics )
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	- Introduction and Motivation
	- Acoustic quantities
	- Acoustic waves
	- Sound sources, sound radiation
	- Sound engergy and intensity
	- Sound propagation
	- Signal processing
	- Psycho acoustics
	- Noise
	- Measurements in acoustics
1.9	Commer L. Haeld M. (1000): Männenskell, Operinger Media.
Literature	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin
	Veit, I. (1988): Technische Akustik. Vogel-Buchverlag, Würzburg
	Veit, I. (1988): Flüssigkeitsschall. Vogel-Buchverlag, Würzburg

Course L0518: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics )	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0807: Boundary I	Element Methods			
-				
Courses				
Title		Тур	Hrs/wk	CP
Boundary Element Methods (L0523) Boundary Element Methods (L0524)		Lecture	2	3 3
	Durat Otto una Estart	Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None	ludractatica Kinamatica Dunamica)		
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (H Mathematics I, II, III (in particular differential equations)	lydrostatics, Kinematics, Dynamics)		
Kilowiedge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge regarding the d	erivation of the boundary element met	hod and are able to	give an overview of the
	theoretical and methodical basis of the method.			
Skills	The students are capable to handle engineering problems by for	rmulating suitable boundary elements a	ssembling the correst	onding system matrices
OKIIIS	and solving the resulting system of equations.	initiating suitable boundary elements, a	ssembling the corresp	Soluting system matrices
Personal Competence				
Social Competence	] -			
Autonomy	The students are able to independently solve challenging com	putational problems and develop own	boundary element ro	utines. Problems can be
	identified and the results are critically scrutinized.			
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	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	ompulsory		
	Energy Systems: Core qualification: Elective Compulsory			
	Computational Science and Engineering: Specialisation Scientific	c Computing: Elective Compulsory		
	Mechanical Engineering and Management: Specialisation Produ	ct Development and Production: Elective	Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsor			
	Product Development, Materials and Production: Core qualification			
	Technomathematics: Specialisation III. Engineering Science: Elec	ctive Compulsory		
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Core qualification: Elective			
	Theoretical Mechanical Engineering: Technical Complementary	Jourse: Elective Compulsory		

Course L0523: Boundary Element M	lethods	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	- Boundary value problems	
	- Integral equations	
	- Fundamental Solutions	
	- Element formulations	
	- Numerical integration	
	- Solving systems of equations (statics, dynamics)	
	- Special BEM formulations	
	- Coupling of FEM and BEM	
	- Hands-on Sessions (programming of BE routines)	
	- Applications	
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden	
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin	



Course L0524: Boundary Element Methods	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



ourses				
tle		Тур	Hrs/wk	CP
actical Course Product Development, N		Laboratory	6	6
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge	Product Development:			
Knowledge	Lectures: Mechanics I-III			
	Lectures: Integrated Product Development Lin	ncl. CAD practical training		
	Materials:			
	Lectures: Structural Metallic Materials, Metalli			
	Lectures: Structure and Properties of Polymer	s, Structure and Properties of Composites, Man	utacturing of Polymers and C	omposites
	Production:			
	Lecture: Production Engineering			
	<ul> <li>Lecture: Forming and Cutting Technology, N</li> </ul>	Aethods of production process design		
	Lectures: Machine Tools and Robotic	icalous of production process design		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can			
	<ul> <li>represent more complex context of different fi</li> </ul>	alda of study		
	<ul> <li>describe functionality of modern measurement</li> </ul>			
Skills	Students are capable of			
	<ul> <li>applying theoretical knowledge for practical a</li> <li>applying provided experimental methods for</li> </ul>			
	<ul> <li>analyzing and evaluating experimental result</li> </ul>			
	<ul> <li>applying modern measurement instrumentati</li> </ul>			
Personal Competence				
Social Competence	Students can			
	<ul> <li>carry out and document experimental work in</li> </ul>	aroups		
	<ul> <li>present and discuss experimental results in n</li> </ul>			
	F			
Autonomy	Students are able to			
	corrupt parts of oversimental work independent	deptly guided by teachers		
	<ul> <li>carry out parts of experimental work independ</li> <li>choose and apply suitable instruments.</li> </ul>	tentry guided by leachers.		
	<ul> <li>assess own strengths and weaknesses.</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale				
Assignment for the Following	Biomedical Engineering: Core qualification: Compute	sory		
Curricula	Product Development, Materials and Production: Co	re qualification: Compulsory		



Course L1566: Practical Course Pro	oduct Development, Materials and Production
Тур	Laboratory
Hrs/wk	6
CP	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Wolfgang Hintze, Prof. Josef Schlattmann, Prof. Dieter Krause, Prof. Claus Emmelmann, Prof. Uwe Weltin, Prof. Bodo Fiedler, Prof. Hermann
	Lödding, Prof. Michael Morlock, Prof. Gerold Schneider, Prof. Thorsten Schüppstuhl, Prof. Otto von Estorff, Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Product Development:
	Modal analysis - experimental and computational
	Appropriate design in engineering
	Characterization of rubbery-elastic materials
	Stick-Slip-Analysis at friction and wear test station
	Materials:
	Property profiles of steel
	Actuators for modern fuel injection systems - synthesis and properties
	Processing, properties and structure of thermoplastic polymers and its composites
	Tribology in joints
	Production:
	Optimization of welding process parameters for hybrid plasma laser welding
	Evaluation of stock removal processes
	Analysis of basic laws in production logistics
	Analysis of positioning behaviour and trajectory accuracy of industrial robots
Literature	Nach Themenstellung / depending on topic



Module M0752: Nonlinear I	Dynamics			
0				
Courses		-		
Title		Typ Lecture	Hrs/wk 4	6 6
Nonlinear Dynamics (L0702)		Lecture	4	б
Module Responsible	Prof. Norbert Hoffmann			
Admission Requirements	None			
Recommended Previous	Calculus			
Knowledge	Linear Algebra			
	Engineering Mechanics			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to reflect existing terms and concepts in Nonline	ear Dynamics and to develop and	research new terms and conce	epts.
Skills	Students are able to apply existing methods and procesures of No	onlinear Dynamics and to develop	o novel methods and procedure	es.
Personal Competence				
Social Competence	Students can reach working results also in groups.			
Autonomy	Students are able to approach given research tasks individually a	nd to identify and follow up novel	research tasks by themselves.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 Hours			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Aircraft Systems: Ele	ctive Compulsory		
Curricula	Computational Science and Engineering: Specialisation Scientific	Computing: Elective Compulsor	у	
	International Management and Engineering: Specialisation II. Me	chatronics: Elective Compulsory		
	Mechanical Engineering and Management: Specialisation Mecha	tronics: Elective Compulsory		
	Mechatronics: Specialisation System Design: Elective Compulsor	Ý		
	Mechatronics: Specialisation Intelligent Systems and Robotics: El	ective Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs and Reg	enerative Medicine: Elective Corr	npulsory	
	Biomedical Engineering: Specialisation Implants and Endoprosth	eses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and	Control Theory: Elective Compuls	sory	
	Biomedical Engineering: Specialisation Management and Busine	ss Administration: Elective Comp	ulsory	
	Product Development, Materials and Production: Core qualification	n: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary (	Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification: Elective	Compulsory		

Course L0702: Nonlinear Dynamics	
Тур	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Norbert Hoffmann
Language	DE/EN
Cycle	SoSe
Content	Fundamentals of Nonlinear Dynamics.
Literature	S. Strogatz: Nonlinear Dynamics and Chaos. Perseus, 2013.



Courses				
Title		Тур	Hrs/wk	CP
Design Optimization and Probabilistic App	roaches in Structural Analysis (L1873)	Lecture	2	3
Design Optimization and Probabilistic App	roaches in Structural Analysis (L1874)	Recitation Section (large)	2	3
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous	Technical mechanics			
Knowledge	Higher math			
	• Ingherman			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Desire estimication			
	Design optimization			
	Gradient based methods			
	Genetic algorithms     Optimization with constraints			
	Optimization with constraints			
	<ul><li>Topology optimization</li><li>Reliability analysis</li></ul>			
	Stochastic basics			
	Monte Carlo methods			
	Semi-analytic approaches			
	<ul> <li>robust design optimization</li> </ul>			
	Robustness measures			
	<ul> <li>Coupling of design optimization and reliability a</li> </ul>	nalveis		
Skills	<ul> <li>Application of optimization algorithms and probabilistic</li> </ul>	mothods in the design of structures		
	Programming with Matlab	menous in the design of structures		
	Implementation of algorithms			
	Debugging			
	bobagging			
Personal Competence				
Social Competence	Team work			
	<ul> <li>Oral explanation of the the work</li> </ul>			
Autonomy				
	Application of methods learned in the framework of a h	ome work		
	Familiarizing with source code provided			
	<ul> <li>Description of approaches and results</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Homework			
Examination duration and scale				
Assignment for the Following	Aircraft Systems Engineering: Specialisation Air Transportation	Systems: Elective Compulsory		
Curricula	Product Development, Materials and Production: Core qualific	ation: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementa	ry Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification: Electi	ve Compulsorv		



Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	In the course the theoretic basics for design optimization and reliability analysis are taught, where the focus is on the application of such methods. The lectures will consist of presentations as well as computer exercises. In the computer exercises, the methods learned will be implemented in Matlab fo understanding the practical realization.
	The following contents will be considered:
	Design optimization
	Gradient based methods
	Genetic algorithms
	Optimization with constraints
	<ul> <li>Topology optimization</li> </ul>
	Reliability analysis
	Stochastic basics
	Monte Carlo methods
	Semi-analytic approaches
	robust design optimization
	Robustness measures
	<ul> <li>Coupling of design optimization and reliability analysis</li> </ul>
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011.
	[2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, Uk 2000.
	1
1874: Design Optimization	and Probabilistic Approaches in Structural Analysis
Тур	Recitation Section (large)

Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	Matlab exercises complementing the lecture
Literature	siehe Vorlesung



Module M0806: Technical A	Acoustics II (Room Acoustics, Computational N	<i>l</i> lethods)		
Courses				
Title		Тур	Hrs/wk	CP
Technical Acoustics II (Room Acoustics,	Technical Acoustics II (Room Acoustics, Computational Methods) (L0519)		2	3
Technical Acoustics II (Room Acoustics,	Computational Methods) (L0521)	Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous	Technical Acoustics I (Acoustic Waves, Noise Protection, Psych	o Acoustics)		
Knowledge				
	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics)			
	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the followi	na loarnina rosulte		
	Alter taking part successionly, subdents have reached the following	ing learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge in acoustics regarding room acoustics and computational methods and are able to give an overview of the			
	corresponding theoretical and methodical basis.			
Skills	The students are capable to handle engineering problems in acoustics by theory-based application of the demanding computational methods procedures treated within the module.			
Personal Competence				
Social Competence				
Autonomy	The students are able to independently solve challenging aco	ustical problems in the areas treated wit	hin the module. Possib	le conflicting issues and
	limitations can be identified and the results are critically scrutini	•		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Cabin Systems: El	ective Compulsory		
Curricula	Mechatronics: Specialisation System Design: Elective Compuls	ory		
	Product Development, Materials and Production: Core qualifica	tion: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation Product De	velopment and Production: Elective Com	pulsory	

Course L0519: Technical Acoustics II (Room Acoustics, Computational Methods)				
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Otto von Estorff			
Language	EN			
Cycle	WiSe			
Content	- Room acoustics			
	- Sound absorber			
	- Standard computations			
	- Statistical Energy Approaches			
	- Finite Element Methods			
	- Boundary Element Methods			
	- Geometrical acoustics			
	- Special formulations			
	- Practical applications			
	- Hands-on Sessions: Programming of elements (Matlab)			
Litereture	Commer L. Handil M. (1000). Kärnenschell, Commer Vader, Davlin			
Literature	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin Veit, I. (1988): Technische Akustik. Vogel-Buchverlag, Würzburg			
	Veit, I. (1988): Flüssigkeitsschall. Vogel-Buchverlag, Würzburg			
	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden			
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin			

Course L0521: Technical Acoustics II (Room Acoustics, Computational Methods)		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



lodule M1140: Technical (	Complementary Course Core Studies for PEPMS (according to Subject Specif	ic Regulations)	
courses			
ïtle	Тур	Hrs/wk	CP
Module Responsible	Prof. Dieter Krause		
Admission Requirements	None		
Recommended Previous	See selected module according to FSPO		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	see selected module according to FSPO		
Skills	see selected module according to FSPO		
Personal Competence			
Social Competence	see selected module according to FSPO		
Autonomy	see selected module according to FSPO		
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0		
Credit points	6		
Examination	according to Subject Specific Regulations		
Examination duration and scale	See selected module according to FSPO		
Assignment for the Following	Product Development, Materials and Production: Core qualification: Elective Compulsory		
Curricula			



Module M1184: Research F	Project Product Development, Materials and Production		
Courses			
Title	Typ Hrs/wk CP		
Module Responsible	Dozenten des Studiengangs		
Admission Requirements	None		
Recommended Previous	Subjects of the Master program and the chosen specialisation.		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	<ul> <li>Students can explain the project as well as their autonomously gained knowledge and relate it to current issues of their field of study.</li> <li>They can explain the basic scientific methods they have worked with.</li> </ul>		
Skills	The students are able to autonomously solve a limited scientific task under the guidance of an experienced researcher. They can justify and explain the approach for problem solving; they can draw conclusions from their results, and then can find new ways and methods for their work. Students ar capable of comparing and assessing alternative approaches with their own with regard to given criteria.		
Personal Competence			
Social Competence	The students are able to condense the relevance and the structure of the project work, the work procedure and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their peers and supervisors.		
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.		
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0		
Credit points	12		
Examination	Project (accord. to Subject Specific Regulations)		
Examination duration and scale			
Assignment for the Following Curricula	Product Development, Materials and Production: Core qualification: Compulsory		

## **Specialization Product Development**

In the product development specialization, graduates learn to work systematically and methodically on challenging design tasks. They have a wide knowledge of new development methods, are able to select appropriate solution strategies and use these autonomously to develop new products. They are qualified to use the approaches of integrated product development, such as simulation or modern testing procedures, for example for the development of lightweight products. With their additional knowledge about modern highperformance materials and production processes graduates can design products on the cutting edge of technology, calculate and actively promote the development of products using modern methods.

Module M0763: Aircraft Sys	stems I			
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Systems I (L0735)		Lecture	3	4
Aircraft Systems I (L0739)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Hydraulics			
	Control Systems			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to:			
	<ul> <li>Describe essential components and design points of h</li> </ul>	vdraulic, electrical and high-lift systems		
	<ul> <li>Give an overview of the functionality of air conditioning</li> </ul>			
	Explain the need for high-lift systems such as ist function	onality and effects		
	Assess the challenge during the design of supply system	ems of an aircraft		
Skills	Students are able to:			
	<ul> <li>Design hydraulic and electric supply systems of aircraft</li> </ul>	ts		
	Design high-lift systems of aircrafts			
	Analyze the thermodynamic behaviour of air condition	ing systems		
Personal Competence				
Social Competence	Students are able to:			
	Perform system design in groups and present and disc	uss results		
Autonomy	Students are able to:			
	<ul> <li>Reflect the contents of lectures autonomously</li> </ul>			
Alterated and the Lit	Jackson dest Obels Terrs 140, Obels Time in Landard To			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points Examination	o Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Elective Cor	npulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory	···		
	International Management and Engineering: Specialisation II.	Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation		ту.	
	Product Development, Materials and Production: Specialisation	on Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisatic			
	Theoretical Mechanical Engineering: Specialisation Aircraft Specialisation			
	Theoretical Mechanical Engineering: Technical Complementa			
	Theoretical Mechanical Engineering: Technical Complementa	try Course: Elective Compulsory		



Course L0735: Aircraft Systems I	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>

Course L0739: Aircraft Systems I	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1024: Methods of	Integrated Product Development			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Product Development II (L1254)		Lecture	3	3
Integrated Product Development II (L1255)	)	Problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Basic knowledge of Integrated product development and applying	CAE systems		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following $% \label{eq:constraint}$	learning results		
<b>Professional Competence</b>				
Knowledge	After passing the module students are able to:			
	<ul> <li>explain technical terms of design methodology,</li> </ul>			
	<ul> <li>describe essential elements of construction management,</li> </ul>			
	describe current problems and the current state of research	of integrated product development.		
Skills	After passing the module students are able to:			
		select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions,		
	solve product development problems with the assistance of a workshop based approach,			
	choose and execute appropriate moderation techniques.			
Personal Competence				
Social Competence	After passing the module students are able to:			
	<ul> <li>prepare and lead team meetings and moderation processe</li> </ul>	S,		
	<ul> <li>work in teams on complex tasks,</li> </ul>			
	represent problems and solutions and advance ideas.			
Autonomy	After passing the module students are able to:			
	<ul> <li>give a structured feedback and accept a critical feedback,</li> </ul>			
	<ul> <li>implement the accepted feedback autonomous.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 Minuten			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elect			
Gurricula	Aircraft Systems Engineering: Specialisation Air Transportation Sy International Management and Engineering: Specialisation II. Proc			
	Mechatronics: Specialisation System Design: Elective Compulsory		ave Compulsory	
	Product Development, Materials and Production: Specialisation Pr			
	Product Development, Materials and Production: Specialisation Pr			
	Product Development, Materials and Production: Specialisation Materials			
	Theoretical Mechanical Engineering: Technical Complementary C			
	Theoretical Mechanical Engineering: Specialisation Product Deve		ulsory	



Course L1254: Integrated Product D	levelopment II
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Lecture
	The lecture extends and enhances the learned content of the module "Integrated Product Development and lightweight design" and is based on the knowledge and skills acquired there.
	Topics of the course include in particular: <ul> <li>Methods of product development,</li> <li>Presentation techniques,</li> </ul>
	<ul> <li>Industrial Design,</li> </ul>
	Design for variety
	Modularization methods,
	Design catalogs,
	Adapted QFD matrix,
	Systematic material selection,
	Assembly oriented design,
	Construction management
	CE mark, declaration of conformity including risk assessment,
	Patents, patent rights, patent monitoring
	Project management (cost, time, quality) and escalation principles,
	Development management for mechatronics,
	Technical Supply Chain Management.
	Exercise (PBL)
	In the exercise the content presented in the lecture "Integrated Product Development II" and methods of product development and design managemen will be enhanced.
	Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currently existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussions and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	Andressen MM. Design for Assembly, Design 1995
	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.     Ashby, M.E.: Materials Selection in Machanical Design, München, Speltrum 2007.
	Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.
	<ul> <li>Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.</li> <li>Hartmann, M. Bieger, M. Funk, B. Bath, H.: Zielgerichtet moderieren, Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Belt</li> </ul>
	<ul> <li>Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch f ür F ührungskr äfte, Berater und Trainer, Weinheim, Belt 2007.</li> </ul>
	<ul> <li>Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.</li> <li>Bath K H.: Konstruktions mit Konstruktionskatalogon, Bond 1.2, Borlin, Springer 2000.</li> </ul>
	<ul> <li>Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000.</li> <li>Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.</li> </ul>
	• ompoon, r.w., olduique, z., oldu, n.u. Floudul Flationn and Floudul Family Design. Methods and Applications, New YOR, Splingel 2013.

Course L1255: Integrated Product D	Course L1255: Integrated Product Development II	
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module Manual M. Sc. "Product Development, Materials and Production"



Module M1025: Fluidics				
Courses				
Title		Тур	Hrs/wk	CP
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Problem-based Learning	-	2
Fluidics (L1257)		Recitation Section (large)	1	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Good knowledge of mechanics (stereo statics, elastostatics, h	ydrostatics, kinematics and kinetics), fluid m	echanics, and enginee	ring design
Knowledge				
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			
	<ul> <li>explain structures and functionalities of hydrostatic, pn</li> </ul>	eumatic, and hydrodynamic components,		
	<ul> <li>explain the interaction of hydraulic components in hydraulic comp</li></ul>			
	<ul> <li>explain open and closed loop control of hydraulic syst</li> </ul>			
	<ul> <li>describe functioning and applications of hydrodynam</li> </ul>		is well as centrifugal p	umps and aggregates
	plant technology	•	0 1	
Skille	After passing the module students are able to			
OKIIIS	Alter passing the module students are able to			
	<ul> <li>analyse and assess hydraulic and pneumatic components and systems,</li> </ul>			
	design and dimension hydraulic systems for mechanical applications,			
	<ul> <li>perform numerical simulations of hydraulic systems based on abstract problem definitions,</li> </ul>			
	select and adapt pump characteristic curves for hydraulic systems			
	dimension hydrodynamic torque converters and brake	s for mechanical aggregates.		
Personal Competence				
Social Competence	After passing the module students are able to			
	discuss and present functional context in groups,			
	organise teamwork autonomously.			
Autonomy	After passing the module students are able to			
	<ul> <li>obtain necessary knowledge for the simulation.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination Examination duration and scale	Written exam			
Assignment for the Following	90 International Management and Engineering: Specialisation II.	Mechatronics: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II.		tive Compulsory	
Gurneula	Product Development, Materials and Production: Specialisation		ave compulsory	
		,		
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Specialisation Product I		buisory	
	Theoretical Mechanical Engineering: Technical Complementa	ary Course: Elective Compulsory		



Course L1256: Fluidics	
	Lastura
Тур	2
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Lecture
	Hydrostatics
	physical fundamentals
	hydraulic fluids
	hydrostatic machines
	valves
	components
	hydrostatic transmissions
	examples from industry
	Pneumatics
	generation of compressed air
	pneumatic motors     Examples of use
	• Examples of use
	Hydrodynamics
	physical fundamentals
	hydraulic continous-flow machines
	hydrodynamic transmissions
	interoperation of motor and transmission
	Exercise
	Hydrostatics
	reading and design of hydraulic diagrams
	dimensioning of hydrostatic traction and working drives
	performance calculation
	Hydrodynamics
	calculation / dimensioning of hydrodynamic torque converters
	<ul> <li>calculation / dimensioning of centrifugal pumps</li> <li>creating and reading of characteristic curves of pumps and systems</li> </ul>
	creating and reading of characteristic curves of pumps and systems
	Field trip
	<ul> <li>field trip to a regional company from the hydraulic industry.</li> </ul>
	leid inplie a regional company non-the hydraulic industry.
	Exercise
	Numerical simulation of hydrostatic systems
	getting to know a numerical simulation environment for hydraulic systems
	<ul> <li>transformation of a task into a simulation model</li> </ul>
	simulation of common components
	variation of simulation parameters
	<ul> <li>using simulations for system dimensioning and optimisation</li> </ul>
	(partly) self-organised teamwork
Literature	Bücher
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011
	<ul> <li>Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006</li> </ul>
	<ul> <li>Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006</li> </ul>
	Beitz, W., Grote, KH.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage
	Skript zur Vorlesung



Course L1371: Fluidics	
Тур	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course
Course L1257: Fluidics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1

Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title .		Тур	Hrs/wk	CP
Computer and communication technology		Lecture	2	2
Computer and communication technology		Recitation Section (small)	1	1 3
Model-Based Systems Engineering (MBSI	Prof. Ralf God	Problem-based Learning	3	3
Module Responsible				
Admission Requirements Recommended Previous	None Recip knowledge in:			
Knowledge	Basic knowledge in: • Mathematics			
Khowledge	Mathematics     Mechanics			
	Thermodynamics			
	,			
	Electrical Engineering			
	Control Systems			
	Previous knowledge in:			
	Systems Engineering			
Educational Objectives	After taking part successfully, students have reached the follow	ing loorning results		
Professional Competence	Aller taking part successionly, students have reached the follow	ing learning lesuits		
Knowledge	Students are able to:			
Knowledge				
	describe the structure and operation of computer architectures			
	explain the structure and operation of digital communication Networks     applein explain the structure of explane linearented modules evidences (MA) and Aircraft Data Communication Network (ADCN)			
	explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN)     understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems			
	· understand the approach of Model-based Systems Engineen	ing (MDSE) in the design of hardware and so	Jiware-Daseu cabins	systems
Skills	Students are able to:			
	• understand, operate and maintain a Minicomputer			
	build up a network communication and communicate with other network participants			
	• connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network			
	• model system functions by means of formal languages SysML/UML and generate software code from the models			
	execute software code on a minicomputer			
Personal Competence				
Social Competence	Students are able to:			
Social Competence	elaborate partial results and merge with others to form a com			
	· elaborate partial results and merge with others to form a comp			
Autonomy	Students are able to:			
	<ul> <li>organize and schedule their practical tasks</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Aircraft Systems:	Elective Compulsory		
Curricula				
	Aircraft Systems Engineering: Specialisation Cabin Systems: C	, , ,		
	International Management and Engineering: Specialisation II.			
	Product Development, Materials and Production: Specialisatio		ry	
	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio			
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy			
	Theoretical Mechanical Engineering: Openalisation metal of			



Course L1557: Computer and comm	nunication technology in cabin electronics and avionics			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Ralf God			
Language	DE			
Cycle	WiSe			
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic			
	systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays			
	requires a basic understanding of cabin electronics and avionics.			
	The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and			
	applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:			
	History of computer and network technology			
	Layer model in computer technology			
	Computer architectures (PC, IPC, Embedded Systems)			
	BIOS, UEFI and operating system (OS)			
	Programming languages (machine code and high-level languages)			
	Applications and Application Programming Interfaces			
	External interfaces (serial, USB, Ethernet)			
	Layer model in network technology			
	Network topologies			
	Network components			
	Bus access procedures			
	Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)			
	Cabin electronics and cabin networks			
Literature	- Skript zur Vorlesung			
	- Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books			
	on Demand; 1. Auflage, 2003			
	- Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1			
	Auflage, 2004			
	- Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren			
	Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006			

Course L1558: Computer and comm	nunication technology in cabin electronics and avionics
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics.
	The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:      History of computer and network technology      Layer model in computer technology      Computer architectures (PC, IPC, Embedded Systems)      BIOS, UEFI and operating system (OS)      Programming languages (machine code and high-level languages)      Applications and Application Programming Interfaces      External interfaces (serial, USB, Ethernet)      Layer model in network technology      Network topologies      Network components      Bus access procedures      Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)      Cabin electronics and cabin networks
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003</li> <li>Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004</li> <li>Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und enweiterte Auflage, 2006</li> </ul>



Course L1551: Model-Based System	ns Engineering (MBSE) with SysML/UML
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011



Module M0511: Electricity C	Generation from Wind and Hydro Power			
Courses				
Courses		<b>T</b>	Hare fords	0.5
Title		Тур	Hrs/wk	CP
Renewable Energy Projects in Emerged N	larkets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013) Wind Turbing Planta (L0011)		Lecture		3
Wind Turbine Plants (L0011)         Lecture         2           Wind Energy Use - Focus Offshore (L0012)         Lecture         1			1	
Module Responsible		2001010	•	•
Admission Requirements	None			
Recommended Previous	Module: Technical Thermodynamics I,			
Knowledge				
	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of wate power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe.			
	Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of theoretical background and are thus able to transfer what they have learned in practice.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
Social Competence	Students can discuss scientific tasks subjet-specificly and mul	tidisciplinary within a seminar.		
Autonomy	Students can independently exploit sources in the context of	the emphasis of the lecture material to c	lear the contents of the l	ecture and to acquire the
	particular knowledge about the subject area.			
We wild a set in the same				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elect			
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E			
	Civil Engineering: Specialisation Coastal Engineering: Elective			
	Energy and Environmental Engineering: Specialisation Energy			
	International Management and Engineering: Specialisation II.			
	International Management and Engineering: Specialisation II.			
	Product Development, Materials and Production: Specialisatio		Isory	
	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio	n Materials: Elective Compulsory		
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process E			
	Water and Environmental Engineering: Specialisation Environ			
	Water and Environmental Engineering: Specialisation Cities: E	Elective Compulsory		



Course L0014: Renewable Energy	Twinete in Emerged Markete
Course L0014: Renewable Energy F	
Тур	Project Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Andreas Wiese
Language	DE
Cycle	SoSe
Content	1. Introduction
	Development of renewable energies worldwide
	<ul> <li>Bevelopment of references wondwide</li> <li>History</li> </ul>
	<ul> <li>Filture markets</li> </ul>
	<ul> <li>Special challenges in new markets - Overview</li> </ul>
	2. Sample project wind farm Korea
	Survey     Technical Description
	Project phases and characteristics
	3. Funding and financing instruments for EE projects in new markets
	Overview funding opportunitie     Overview countries with feed-in laws
	Major funding programs
	4. CDM projects - why, how , examples
	Overview CDM process
	• Examples
	• Exercise CDM
	5. Rural electrification and hybrid systems - an important future market for EE
	Rural Electrification - Introduction
	• Types of Elektrizifierungsprojekten
	The role of the EEInterpretation of hybrid systems
	Project example: hybrid system Galapagos Islands
	6. Tendering process for EE projects - examples
	South Africa
	• Brazil
	7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank
	• Geothermal
	Wind or CSP
	Within the seminar, the various topics are actively discussed and applied to various cases of application.
Literature	Folien der Vorlesung

Course L0013: Hydro Power Use	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Stephan Heimerl
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction, importance of water power in the national and global context</li> <li>Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies</li> <li>Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems</li> <li>Construction of hydroelectric power plants: description of the individual components and their technical system interaction</li> <li>Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc.</li> <li>Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection</li> <li>Hydropower and the Environment</li> <li>Examples from practice</li> </ul>
Literature	<ul> <li>Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage</li> <li>Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage</li> <li>Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage</li> <li>von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage</li> <li>Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006</li> </ul>



Course L0011: Wind Turbine Plants	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann
Language	DE
Cycle	SoSe
Content	<ul> <li>Historical development</li> <li>Wind: origins, geographic and temporal distribution, locations</li> <li>Power coefficient, rotor thrust</li> <li>Aerodynamics of the rotor</li> <li>Operating performance</li> <li>Power limitation, partial load, pitch and stall control</li> <li>Plant selection, yield prediction, economy</li> <li>Excursion</li> </ul>
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy Use - F	ocus Offshore
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering</li> <li>Physical fundamentals for utilization of wind energy</li> <li>Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships</li> <li>Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures of an offshore wind farm, Inner Park cabling, offshore substation, grid connection</li> <li>Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics</li> <li>Development and planning of offshore wind farms</li> <li>Operation and optimization of offshore wind farms</li> <li>Day excursion</li> </ul>
Literature	<ul> <li>Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage</li> <li>Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage</li> <li>Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage</li> <li>Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage</li> </ul>



Courses				
Title		Тур	Hrs/wk	CP
Supply Chain Management (L1218)		Problem-based Learning	3	4
Value-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	None			
Recommended Previous	no			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence		J		
Knowledge	Current developments in international business activities such as o	utsourcing, offshoring, internationaliz	ation and globalizatio	on and emerging mark
	illustrated by examples from practice.			
	Theoretical Approaches and methods in logistics and supply chain	management and use in practice.		
	• to identify fields of decision in SCM .			
	<ul> <li>reasons for the formation of networks based on various theories from</li> </ul>	m institutional economics (transactio	on cost theory, princip	al-agent theory, prope
	right theory) and the resource-based view.	X	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0 ,,, ,
	<ul> <li>Selected approaches to explain the development of networks.</li> </ul>			
	<ul> <li>to illustrate phases of network formation.</li> </ul>			
	• to understand the functional mechanisms of inter-organizational and	d international network relationships.		
	• to explain and categorize relationships within networks.			
	• to categorize sourcing concepts and explain motives/ barriers or ad	vantages and disadvantages.		
	• advantages and disadvantages of offshoring and outsourcing and to	illustrate the distinction between the	two terms .	
	• to state criteria/ factors/ parameters that influence production locatio	n decisions at the global level (total n	etwork costs).	
	<ul> <li>to explain methods for location finding/evaluation.</li> </ul>			
	<ul> <li>to interpret phenotypes of production networks.</li> </ul>			
	• recognize relationships between R & D and production and their loc	ations and to describe coherent mod	els.	
	• to solve sub-problems with the configuration of logistics networks (d	istribution and spare parts networks )	by the use of approp	riate approaches.
	• to categorise special waste logistics including their duties & objective	es and to state and describe practica	l examples of good n	etworking.
		chains and locistics actually and the		
Skills	<ul> <li>to asses trends and challenges in national and international supply chains and logistics networks and their consequences for companies.</li> <li>to evaluate, anaylse and systematise networks and network relations based on the lecture.</li> </ul>			companies.
	<ul> <li>to anaylse partners and their suitability for co-operation in collaborations and cooperative relations.</li> <li>to select sourcing concepts for specific products / product components based on the lecture as well as advantages and disadvantage</li> </ul>			
	approach.		in as advantages an	a disadvantages of et
	<ul> <li>to evaluate location decisions for production and R &amp; D based on control</li> </ul>	oncepts.		
	• to recognize relationships between R & D and production as we		the suitability of sp	acific models for differ
	situations.		, , , , , , , , , , , , , , , , , , ,	
	<ul> <li>to transfer the analyzed concepts to international practices.</li> </ul>			
	<ul> <li>to analyse and evaluate the product development processes.</li> </ul>			
	• to anaylse concepts of Information and communication managemen	t in logistics.		
	• to design subcontracting, procurement, production and disposal as	well as R & D networks to shape,		
	• to plan reorganise efficient and flow-oriented enterprise networks.			
	• to adopt methods of complexity management and risk management	in logistics.		
Personal Competence				
Social Competence	• to evaluate intercultural and international relationships based on dis			
	advance planning and design of network formation and their object			
	definition of procurement strategies for individual parts using the ga			
	design of the procurement network (external/internal/modules etc.)	based on the sourcing concepts and	core competencies,	as well as on the findli
	of the case studies. <ul> <li>to make decision of location for production taking into account g</li> </ul>	label contexts evoluction methods	and huving/colling r	norkata which word a
	discussed in the case studies and their dependence on R & D.	nobal contexts, evaluation methods	and buying/sening i	narkets, which were a
	<ul> <li>Decision on R &amp; D locations based on the insights gained from case</li> </ul>	studios (practical examples and the	coloction of an appro	priato model
	· Decision of the Diocations based on the insights gamed from case	studies / practical examples and the	selection of an appro	phate model.
Autonomy	After completing the module students are capable to work independent	endently on the subject of Supply C	Chain Management a	and transfer the acqui
	knowledge to new problems.			
Madde - 15 11.	Independent Study Time 110, Study Time is Last as 70			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	International Management and Engineering: Specialisation I. Elective		/	
Curricula	Logistics, Infrastructure and Mobility: Specialisation Production and L			
	Product Development, Materials and Production: Specialisation Prod		ry	
	Product Development, Materials and Production: Specialisation Prod	uction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Mate			



	ement
Тур	Problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	SoSe
Content	<ul> <li>Transmission of a profound understanding in logistics and supply chain management</li> <li>Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts t business cases</li> <li>Identification of trends and challenges in national and international supply chains</li> <li>Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push c pull-based strategies, efficiency vs. responsiveness)</li> <li>Elaboration of approaches and goals in the field of resource planning and supplier management</li> <li>Identification and analyzes of concepts in logistics management</li> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul>
Literature	<ul> <li>Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin.</li> <li>Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3<sup>rd</sup> edition, Upper Saddle River, NJ, Pearson/Prentice Hall.</li> <li>Heizer, J. und Render, B. (2006): Principles of Operations Management. Prentice Hall.</li> <li>Fisher, M. (1997): What is the right supply chain for your product?, Harvard Business Review, Vol. 75, No. pp., S. 105-116.</li> <li>Kuhn, A. und Hellingrath, B. (2002): Supply Chain Management: optimierte Zusammenarbeit in der Wertschöpfungskette, Berlin [u.a.], Springer.</li> <li>Larson, P., Poist, R., Halldórsson, Á. (2007): PERSPECTIVES ON LOGISTICS VS. SCM: A SURVEY OF SCM PROFESSIONALS, in: Journal of Busines Logistics, Vol. 28, No. 1, 2007, S. 3ff.</li> <li>Kummer, S., Hrsg. (2006): Grundzüge der Beschaffung, Produktion und Logistik, München: Pearson Studium.</li> <li>Porter, M. (1986): Changing Patterns of International Competition, California Management Review, Vol. 28, No. 2, pp. 9-40.</li> <li>Simchi-Levi, D., Kaminsky, P. und Simchi-Levi, E. (2008): Designing and managing the supply chain: concepts, strategies and case studies, 3. ec McGraw-Hill.</li> <li>Supply Chain Council (2010): Supply Chain Operations Reference (SCOR) model: Overview – Version 10.0, [online] :: http://supplychain.org//Web Scc Overview.pdf.</li> <li>Swink, M., Melnyk, S. A., Cooper, M. B., Hartley, J. L. (2011): Managing Operations – Across the Supply Chain. McGraw-Hill/Irwin.</li> </ul>



Course L1190: Value-Adding Netwo	rks
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Blecker
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>



d Navigation in Medicine			
Title		Hrs/wk	CP
5)	Lecture	2	3
	Project Seminar	2	2
6)	Recitation Section (small)	1	1
Prof. Alexander Schlaefer			
None			
• principles of math (algebra, analysis/calculus)			
<ul> <li>principles of programming, e.g., in Java or C++</li> <li>solid R or Matlab skills</li> </ul>			
After taking part successfully, students have reached the	he following learning results		
The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in details. Systems can be evaluated with respect to collision detection and safety and regulations. Students can assess typical systems regarding design and limitations.			
The students are able to design and evaluate navigation systems and robotic systems for medical applications.			
The students discuss the results of other groups, provi	de helpful feedback and can incoorporate feedbac	k into their work.	
The students can reflect their knowledge and document	nt the results of their work. They can present the res	sults in an appropriate r	nanner.
Independent Study Time 110, Study Time in Lecture 7	0		
6			
Written exam			
90 minutes			
Computer Science: Specialisation Intelligence Engine	ering: Elective Compulsory		
Electrical Engineering: Specialisation Medical Techno	logy: Elective Compulsory		
Computational Science and Engineering: Specialisation	on Systems Engineering and Robotics: Elective Co	mpulsory	
International Management and Engineering: Specialis	ation II. Electrical Engineering: Elective Compulsor	y .	
Mechatronics: Specialisation Intelligent Systems and F	Robotics: Elective Compulsory		
Biomedical Engineering: Specialisation Artificial Organ	ns and Regenerative Medicine: Elective Compulso	ry	
Biomedical Engineering: Specialisation Implants and	Endoprostheses: Elective Compulsory		
Biomedical Engineering: Specialisation Medical Tech	nology and Control Theory: Elective Compulsory		
Biomedical Engineering: Specialisation Management	and Business Administration: Elective Compulsory		
Theoretical Mechanical Engineering: Specialisation B	io- and Medical Technology: Elective Compulsory		
	principles of programming, e.g., in Java or C++     solid R or Matlab skills  After taking part successfully, students have reached t  The students can explain kinematics and tracking sy- evaluated with respect to collision detection and safet The students are able to design and evaluate navigati  The students discuss the results of other groups, provi The students can reflect their knowledge and documer Independent Study Time 110, Study Time in Lecture 7 6 Written exam 90 minutes Computer Science: Specialisation Intelligence Engine Electrical Engineering: Specialisation Medical Techno Computational Science and Engineering: Specialisatio International Management and Engineering: Specialisatio Biomedical Engineering: Specialisation Implants and Biomedical Engineering: Specialisation Medical Techno Biomedical Engineering: Specialisation Medical Techno Biomedical Engineering: Specialisation Implants and Biomedical Engineering: Specialisation Medical Techno Biomedical Engineering: Specialisation Medical	e)       Project Seminar         6)       Recitation Section (small)         Prof. Alexander Schlaefer       None         •       principles of math (algebra, analysis/calculus)         •       principles of programming, e.g., in Java or C++         •       solid R or Matlab skills         After taking part successfully, students have reached the following learning results         The students can explain kinematics and tracking systems in clinical contexts and illustrate systems ar evaluated with respect to collision detection and safety and regulations. Students can assess typical syst         The students are able to design and evaluate navigation systems and robotic systems for medical applications are evaluated with respect to collision detection and safety and regulations. Students can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoorporate feedbace the students discuss the results of other groups, provide helpful feedback and can incoo	5) Lecture 2 6) Project Seminar 2 7 7 8) Rectation Section (small) 1 7 7 97 64. Aexander Schlaefer 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

Course L0335: Robotics and Navigation in Medicine	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	- kinematics
	- calibration
	- tracking systems
	- navigation and image guidance
	- motion compensation
	The seminar extends and complements the contents of the lecture with respect to recent research results.
Literature	Spong et al.: Robot Modeling and Control, 2005
	Troccaz: Medical Robotics, 2012
	Further literature will be given in the lecture.

Content

Literature

See interlocking course

See interlocking course



Course L0338: Robotics and Naviga	ourse L0338: Robotics and Navigation in Medicine	
Тур	Project Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	
	- · ·	
Course L0336: Robotics and Naviga	ation in Medicine	
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	EN	
Cycle	SoSe	

Module Manual M. Sc. "Product Development, Materials and Production"



Module M0764: Aircraft Sys	stems II			
Module Moro4. Ancian Sys				
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Systems II (L0736)		Lecture	3	4
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge				
	mathematics     mechanics			
	moonamoo			
	thermo dynamics     electronics			
	fluid technology			
	control technology			
	Control technology			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to			
	den alter den straden af a dan a flister state and		d to all a second second	
	describe the structure of primary flight control system	is as well as actuation-, avionic-, fuel- an	d landing gear-syste	ms in general along wit
	corresponding properties and applications.			
	explain different configurations and designs and their			
	<ul> <li>explain atmospheric conditions for icing such as the fu</li> </ul>	nctionality of anti-ice systems		
Skills	Students are able to			
	<ul> <li>size primary flight control actuation systems</li> </ul>			
	<ul> <li>perform a controller design process for the flight control</li> </ul>	l actuators		
	design high-lift kinematics			
	<ul> <li>design and analyse landing gear systems</li> </ul>			
	<ul> <li>design anti-ice systems</li> </ul>			
Personal Competence				
	Students are able to:			
Social Competence	Students are able to:			
	<ul> <li>Develop joint solutions in mixed teams</li> </ul>			
A 4-	Studente ere oble te :			
Autonomy	Students are able to:			
	derive requirements and perform appropriate yet sim	plified design processes for aircraft system	s from complex issue	s and circumstances in
	self-reliant manner			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II.	Aviation Systems: Elective Compulsory		
Gurricula	Product Development, Materials and Production: Specialisation		urv.	
	Product Development, Materials and Production: Specialisatic		, , , , , , , , , , , , , , , , , , ,	
	Product Development, Materials and Production: Specialisatic			
	Theoretical Mechanical Engineering: Technical Complementa			
	Theoretical Mechanical Engineering: Specialisation Aircraft Sp			
	Theoretical Moonanical Engineering. Opeolansation Aliciait o	stenis Engineering. Liective Compusory		



Course L0736: Aircraft Systems II	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	<ul> <li>Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems)</li> <li>Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems)</li> <li>Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems)</li> <li>Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>Curry: Aircraft Landing Gear Design: Principles and Practices</li> </ul>

Course L0740: Aircraft Systems II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module Manual M. Sc. "Product Development, Materials and Production"



odule M0811: Medical Ima	iging systems			
Courses				
ïtle		Тур	Hrs/wk	CP
Nedical Imaging Systems (L0819)		Lecture	4	6
Module Responsible	Dr. Michael Grass			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge				
	Students can:			
	<ul> <li>Describe the system configuration and compon</li> </ul>	onto of the main clinical imaging systems:		
	<ul> <li>Explain how the system components and the ov</li> </ul>			
	<ul> <li>Explain now the system components and the over-</li> <li>Explain and apply the physical processes that no</li> </ul>			
	<ul> <li>Name and describe the physical effects require</li> </ul>		anientai physical equations,	
	<ul> <li>Explain how spatial and temporal resolution call</li> </ul>		images generated:	
	<ul> <li>Explain which image reconstruction methods and</li> </ul>			
	Describe and explain the main clinical uses of the diffe	rent systems.		
Skills	Students are able to:			
	<ul> <li>Explain the physical processes of images and a</li> </ul>	assign to the systems the basic mathematical	l or physical equations required	:
		stems using the mathematical or physical equ		.1
		em components on the spatial and temporal		
		ing systems for a number of clinical applicati		
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence	none			
Autonomy	Students can:			
	Understand which physical effects are used in r			
	<ul> <li>Decide independently for which clinical issue a</li> </ul>	measuring system can be used.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	3		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Electrical Engineering: Specialisation Medical Technol	ogy: Elective Compulsory		
Curricula	Biomedical Engineering: Core qualification: Compulso	ry		
	Product Development, Materials and Production: Speci		mpulsory	
	Product Development, Materials and Production: Speci			
	Product Development, Materials and Production: Speci			
	Theoretical Mechanical Engineering: Technical Compl			
	Theoretical Mechanical Engineering: Specialisation Bio	o- and Medical Technology: Elective Compu	Isory	
annes 10040. Me d'authors d'auto				
Course L0819: Medical Imaging Sys				
	Lecture			
Hrs/wk	4			

Course L0819: Medical Imaging Sys	iems
Тур	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book:
	1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press
	Secondary books:
	- A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003.
	- W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002.
	- H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995.
	- O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.



## Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Production System	ns (L0927)	Problem-based Learning	2	3
Emotional Design / User Centered Produc	t Development (L1703)	Seminar	2	2
Development Management for Mechatron	ics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Struc	ctures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc	ctures (L0501)	Laboratory Course	1	1
ightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
ightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
ightweight Design Practical Course (L12	58)	Problem-based Learning	3	3
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Applications	(L0514)	Lecture	2	3
kircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)		Lecture	2	4
Productivity Management (L0928)		Problem-based Learning	2	2
Productivity Management (L0931)		Recitation Section (small)	1	1
Feedback Control in Medical Technology	(L0664)	Lecture	2	3
Renewable Energy (L0313)	( )	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	-	- 1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transportation (LO	855)	Lecture	3	3
Fechnical Design (L1513)	555)	Lecture	2	3
		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	2
Materials Testing (L0949)				
Reliability in Engineering Dynamics (L0176			2	2
Reliability in Engineering Dynamics (L1303	3)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge				
	<ul> <li>Students are able to express their extended knowled</li> </ul>	Ige and discuss the connection of different	special fields or app	lication areas of proc
	development, materials and production			
	<ul> <li>Students are qualified to connect different special fields</li> </ul>	s with each other		
Skills	<ul> <li>Students can apply specialized solution strategies and</li> </ul>	now acientific methods in colocted areas		
	<ul> <li>Students are able to transfer learned skills to new and</li> </ul>	unknown problems and can develop own sol	ution approaches	
Personal Competence				
Social Competence	-			
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	12			
	Product Development, Materials and Production: Specialisatio	n Product Development: Elective Compulser	w.	
Assignment for the Following			у	
Curricula	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation	on Materials: Elective Compulsory		



Course L159	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in	Independent Study Time 48, Study Time in Lecture 42
Hours	
Examination	Mündliche Prüfung
Form	
Examination	30 Minuten
duration	
and scale	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrat	Course L0927: Elements of Integrated Production Systems	
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	not available	
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.	
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.	
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.	
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.	
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.	
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.	
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.	

Тур	Jser Centered Product Development Seminar
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben



Course L1512: Development Manag	ement for Mechatronics
Тур	
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>

Course L0310: Fatigue & Damage T	olerance
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,
	environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	
Content	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structur used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of application is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining a Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwei structures as well as their application fields.
Literature	
	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> </ul>
	<ul> <li>J. Statkenold, introduction to materials science for engineers, rientice-nan mematohal</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> </ul>
	D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook
	D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1514: Lightweight Construe	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	Fundamentals of Anisotropic Elasticity
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law
	Behaviour of a single laminate layer
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules
	Fundamentals of Micromechanics of a laminate layer
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin
	Bending of Composite Laminated Plates
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions
	Stress Concentration Problems
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis
	Stability of Thin-Walled Composite Structures
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and the evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	Schürmann H. Konstruioran mit Fasar Kunststaff Varhundan" Sarinzar Parlin aktualla Auflasa
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> </ul>
	<ul> <li>Wiedemann, J., "Lecholad Band T. Elemente , Springer, Benn, Heidelberg, , aktuelle Auliage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Lammated Plates and Shells", Orde Publishing, boda Pation et al., current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.</li> </ul>
	<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> </ul>
	<ul> <li>Herakovich, C. I., "wechanics of horous composites , John Wiley and Sons, inc., New York, current edition.</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>

Course L1515: Lightweight Constru-	Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Dr. Marco Schürg	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
	<ul> <li>getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>Determination of material properties based on sample tests</li> <li>manufacturing of the structure in the composite lab</li> <li>Testing of the developed structure</li> <li>Concept presentation</li> <li>Self-organised teamwork</li> </ul>
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	r Aircraft Applications
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements,
	thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	1. Introduction/process of aircraft design/various aircraft configurations
	2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)
	3. Statistical methods in overall aircraft design/data base methods
	4. Principles of aircraft performance design (stability, V-n-diagramme)
	5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)
	6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)
	7. Principles of engine design and integration
	8. Cruise design
	9. Design of runway and landing field length
	10. Cabin design (fuselage dimensioning, cabin interior, loading systems)
	11. System- and equipment aspects
	12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nance imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVE LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching witk KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivit, pressure sensor: piezoresistive, capacitiv and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabricatio process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnet resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, clark electrode, enzym el</li></ul>
	<ul> <li>Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM ar equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship)</li> <li>System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip ch bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; mic electroplating, 3D-MID)</li> </ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002
	N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity Management	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in	Medical Technology
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Ulf Pilz, Prof. Olaf Simanski
Language	DE
Cycle	SoSe
Content	Taking an engineering point of view, the lecture is structured as follows.
	<ul> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart
	Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag
	M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> <li>Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008</li> </ul>
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L0855: System Analysis in Air Transportation	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>
Literature	Hand out

Course L1513: Technical Design	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Hausarbeit
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



ЗC	. "Product Development, Materials and Production"	Technisc
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	
	DRAWING	
	Barons Educational Series	
	ISBN-13: 978-0-7641-6182-7	
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept	
	Presentation for Designers and Illustrators	
	Watson-Guptil Publication a division of Billboard Publications Inc.,	
	New York 1985	
	AIRWORLD	
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
	Perter Deslius Jacek Slaski te Neues 2005	
	Technik und Sicherheit von Passagierflugzeugen	
	Frank Littek	
	Motorbuch Verlag 2003	
	Jetliner Cabins	
	Jennifer Coutts Clay	
	Cs books England 2006	
	BOEING Widebodies	
	Michael Haenggi motorbooks international USA 2003	
	form - Zeitschrift für Gestaltung, Verlag form GmbH,	
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim	
	(erscheint vierteljährlich, Verlag form GmbH)	
	design report	
	german magasin,	
	(erscheint monatlich)	
	md - möbel interior design, Konradin-Verlag	
	Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen	
	(erscheint monatlich)	
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,	
	Kitashinjuku, Shinjuku-ku, Tokio 160, Japan	
	(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland Gm	ıbH,
	Auto & Design,	
	Corso Frabcia 161, 10139 Torino, Italia	
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei	

[72]

Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technolog	у		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, 5	Study Time in Lecture 28	
Examination Form	Klausur		
Examination duration and scale	90 Minuten		
	Dr. Rolf Janßen		
Language			
Cycle			
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed. Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.		
	Content:	1. Introduction	
	Inhalt: 2	2. Raw materials	
	3	. Powder fabrication	
	4	. Powder processing	
	5. Shape-forming processes		
	6	. Densification, sintering	
	7	. Glass and Cement technology	
	8	. Ceramic-metal joining techniques	
Literature	W.D. Kingery, "Introduction to	Ceramics", John Wiley & Sons, New York, 1975	
	ASM Engineering Materials H	landbook Vol.4 "Ceramics and Glasses", 1991	
	D.W. Richerson, "Modern Cer	ramic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		



Course L0949: Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Enginee	ering Dynamics		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	90 min.		
Lecturer	Prof. Uwe Weltin		
Language	EN		
Cycle	SoSe		
	Method for calculation and testing of reliability of dynamic machine systems   Modeling  System identification  Simulation  Processing of measurement data Damage accumulation  Test planning and execution		
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 L1303: Reliability in Engineering Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 min
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0749: Reliability of Aircraft	Systems
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



Module M1143: Mechanica	Design Methodology			
Courses				
Title		Тур	Hrs/wk	CP
Mechanical Design Methodology (L1523)		Lecture	3	4
Mechanical Design Methodology (L1524)		Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	Science-based working on product design considering targeted ap	plication of specific product design tec	hniques	
Chille			sing grablens / Anglia	ation of continue and that
Skills	Creative handling of processes used for scientific preparation and design techniques following theoretical aspects.	a formulation of complex product de	sign problems / Applic	ation of various product
	design techniques following theoretical aspects.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	International Management and Engineering: Specialisation II. Prod	uct Development and Production: Elec	tive Compulsory	
Curricula	Mechatronics: Specialisation System Design: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regel	nerative Medicine: Elective Compulsor	У	
	Biomedical Engineering: Specialisation Implants and Endoprosthe	ses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and C	ontrol Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Business	Administration: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Pro	oduct Development: Elective Compulso	ory	
	Product Development, Materials and Production: Specialisation Pro	oduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Ma	terials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Develo	opment and Production: Elective Comp	oulsory	
	Theoretical Mechanical Engineering: Technical Complementary Co	ourse: Elective Compulsory		

Course L1523: Mechanical Design	Aethodology	
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Josef Schlattmann	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>	
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>	



Course L1524: Mechanical Design M	Aethodology
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Josef Schlattmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>



Module M1145: Automation	and Simulation			
module mi 143. Automation				
Courses				
Title		Тур	Hrs/wk	CP
Automation and Simulation (L1525)		Lecture	3	3
Automation and Simulation (L1527)		Recitation Section (large)	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	BSc Mechanical Engineering or similar			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students can describe the structure an the function of process programmable logic computers .	computers, the corresponding compo	nents, the data tran	sfer via bus systems ar
	They can describe the basich principle of a numeric simulation and	the corresponding parameters.		
	Thy can explain the usual method to simulate the dynamic behavio	ur of three-phase machines.		
Skills	Students can describe and design simple controllers using establis	shed methodes.		
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.			
	They can modell and simulate technical systems with respect to the	eir dynamical behaviour and can use Ma	atlab/Simulink for the	simulation.
	They are able to applay established methods for the caclulation of	the dynamical behaviour of three-phase	e machines.	
Personal Competence				
Social Competence	Teamwork in small teams.			
Autonomy				
	evaluate the results critically.		,	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde			
Assignment for the Following	Energy Systems: Core qualification: Elective Compulsory			
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elect	ve Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elec			
	International Management and Engineering: Specialisation II. Ene	gy and Environmental Engineering: Ele	ctive Compulsory	
	International Management and Engineering: Specialisation II. Avia	tion Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II. Proc	luct Development and Production: Election	ve Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsory			
	Mechatronics: Specialisation Intelligent Systems and Robotics: Ele	ctive Compulsory		
	Product Development, Materials and Production: Specialisation Pr	oduct Development: Elective Compulso	ry	
	Product Development, Materials and Production: Specialisation Pr	oduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Ma	aterials: Elective Compulsory		



Course L1525: Automation and Simulation		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	NN	
Language	DE	
Cycle	SoSe	
Content	Structure of automation systsems	
	Aufbau von Automationseinrichtungen	
	Structure and function of process computers and corresponding componentes	
	Data transfer via bus systems	
	Programmable Logic Computers	
	Methods to describe logic sequences	
	Prionciples of the modelling and the simulation of continous technical systems	
	Practical work with an established simulation program (Matlab/Simulink)	
	Simulation of the dynamic behaviour of a three-phase maschine, simulation of a mixed continous/discrete system on base of tansistion flow diagrams.	
Literature	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag	
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag	
	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag	
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren	

course L1527: Automation and Simulation	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M1156: Systems Er	ngineering			
Courses				
Title		Тур	Hrs/wk	CP
Systems Engineering (L1547)		Lecture	3	4
Systems Engineering (L1548)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
	Previous knowledge in:			
	Aircraft Cabin Systems			
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	Students are able to:			
	• understand systems engineering process models, methods and too	Is for the development of complex Sys	stems	
	describe innovation processes and the need for technology Manage	ement		
	• explain the aircraft development process and the process of type ce	rtification for aircraft		
	• explain the system development process, including requirements for	r systems reliability		
	• identify environmental conditions and test procedures for airborne E	quipment		
	• value the methodology of requirements-based engineering (RBE) a	nd model-based requirements engine	eering (MBRE)	
Skills	Students are able to:			
	plan the process for the development of complex Systems			
	organize the development phases and development Tasks			
	<ul> <li>assign required business activities and technical Tasks</li> </ul>			
	<ul> <li>apply systems engineering methods and tools</li> </ul>			
Devected Competence				
Personal Competence	Students are able to:			
Social Competence		agrate themselves with their rate is the	o ovorall process	
	understand their responsibilities within a development team and int	שימנס נוופווואפוזיפא שונוו נוופוו וטופ ווז (חפ	- overall process	
Autonomy	Students are able to:			
	interact and communicate in a development team which has distributed	uted tasks		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination				
Examination duration and scale				
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II. Aviatio	n Systems: Elective Compulsorv		
	International Management and Engineering: Specialisation II. Produc		ve Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsory			
	Mechatronics: Specialisation Intelligent Systems and Robotics: Electi	ve Compulsory		
	Product Development, Materials and Production: Specialisation Prod			
	Product Development, Materials and Production: Specialisation Prod			
	Product Development, Materials and Production: Specialisation Mate			
	Theoretical Mechanical Engineering: Technical Complementary Cou			
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems			
	internetient meenanieur Engineering, opeolandaton vinoialt Oystems	Country		



Course L1547: Systems Engineerin	g	
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Ralf God	
Language	DE	
Cycle	SoSe	
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems	
	using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved.	
	Regulations, guidelines and certification issues will be known.	
	Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools	
	and methods for systems engineering:	
	Innovation processes	
	IP-protection	
	Technology management	
	Systems engineering	
	Aircraft program	
	Certification issues	
	Systems development	
	Safety objectives and fault tolerance	
	Environmental and operating conditions	
	Tools for systems engineering	
	Requirements-based engineering (RBE)	
	Model-based requirements engineering (MBRE)	
Litereture		
Literature	- Skript zur Vorlesung	
	- diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE) - Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010	
	- Hauschlidt, J., Satorno, S., Innovationsmanagement, vanien, S. Adnage, 2010 - NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007	
	- Hinsch, M.: Industrielles Luffahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010	
	- Thisch, M.: Industrenes Education and agement. Technik and Organisation Initial Intechnischer Bernebe. Springer, 2010	
	- Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008	

Course L1548: Systems Engineerin	ourse L1548: Systems Engineering		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1161: Turbomach	hinery			
	intery			
Courses				
Title		Тур	Hrs/wk	CP
Turbomachines (L1562)		Lecture	3	4
Turbomachines (L1563)		Recitation Section (large)	1	2
Module Responsible	Prof. Franz Joos			
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	The students can			
	<ul> <li>distinguish the physical phenomena of conversion of energy</li> </ul>			
	<ul> <li>understand the different mathematic modelling of turbomach</li> </ul>			
	<ul> <li>calculate and evaluate turbomachinery.</li> </ul>	- ,,		
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
	<ul> <li>discuss in small groups and develop an approach.</li> </ul>			
Autonomy	The students are able to			
	develop a complex problem self-consistent,			
	<ul> <li>analyse the results in a critical way,</li> <li>have an available of a value of a</li></ul>			
	<ul> <li>have an qualified exchange with other students.</li> </ul>			
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	Energy Systems: Specialisation Energy Systems: Compulsory			
Curricula	Energy Systems: Specialisation Marine Engineering: Elective Comp	ulsory		
	Product Development, Materials and Production: Specialisation Pro-	duct Development: Elective Compulso	ry	
	Product Development, Materials and Production: Specialisation Pro-	duction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Mat	erials: Elective Compulsory		

Course L1562: Turbomachines		
Тур	Lecture	
Hrs/wk		
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	Topics to be covered will include:	
	<ul> <li>Application cases of turbomachinery</li> <li>Fundamentals of thermodynamics and fluid mechanics</li> <li>Design fundamentals of turbomachinery</li> <li>Introduction to the theory of turbine stage</li> <li>Design and operation of the turbocompressor</li> <li>Design and operation of the steam turbine</li> <li>Design and operation of the gas turbine</li> <li>Physical limits of the turbomachines</li> </ul>	
Literature	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>	



Course L1563: Turbomachines	Course L1563: Turbomachines	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1170: Phenomen	a and Methods in Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Experimental Methods for the Characteriz	ation of Materials (L1580)	Lecture	2	3
Phase equilibria and transformations (L15	79)	Lecture	2	3
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 follo	wing learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of adva	nced materials along with their applica	ations in technology, in pa	ticular metallic, ceramic
	polymeric, semiconductor, modern composite materials (biom	naterials) and nanomaterials.		
Skilla	The students will be able to calest material configurations	according to the technical people and	if papagany to design p	w motoriala considering
Skiils	The students will be able to select material configurations architectural principles from the micro- to the macroscale. Th			
	select optimum materials combinations depending on the tecl	-	in modern materials science	e, which enables them to
	select optimum materials combinations depending on the tech			
Personal Competence				
Social Competence	The students are able to present solutions to specialists and t	o develop ideas further.		
Autonomy	The students are able to			
	<ul> <li>assess their own strengths and weaknesses.</li> </ul>			
	define tasks independently.			
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	International Management and Engineering: Specialisation II.	Product Development and Production:	Elective Compulsory	
Curricula	Materials Science: Core qualification: Compulsory		. ,	
	Product Development, Materials and Production: Specialisation	on Product Development: Elective Com	pulsory	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Specialisation Materials	Science: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementa			
	Theoretical Mechanical Engineering: Specialisation Materials			
	Theoretical Mechanical Engineering: Technical Complementa			

Course L1580: Experimental Methods for the Characterization of Materials		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Patrick Huber	
Language	DE/EN	
Cycle	SoSe	
Content	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>	
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 L1579: Phase equilibria and	Course L1579: Phase equilibria and transformations		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Jörg Weißmüller		
Language	DE		
Cycle	SoSe		
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.		
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.		



## Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses					
Title		Тур	Hrs/wk	CP	
Applied Automation (L1592)		Problem-based Learning	3	3	
Ergonomics (L0653)		Lecture	2	3	
Elements of Integrated Production System		Problem-based Learning	2	3	
Emotional Design / User Centered Produc	t Development (L1703)	Seminar	2	2	
Development Management for Mechatron	ics (L1512)	Lecture	2	3	
Fatigue & Damage Tolerance (L0310)		Lecture	2	3	
Joining of Polymer-Metal Lightweight Strue	ctures (L0500)	Lecture	2	2	
Joining of Polymer-Metal Lightweight Strue	ctures (L0501)	Laboratory Course	1	1	
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2	
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1	
Lightweight Design Practical Course (L12	58)	Problem-based Learning	3	3	
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2	
Metallic Materials for Aircraft Applications	(L0514)	Lecture	2	3	
Aircraft Design I (L0820)		Lecture	2	2	
Aircraft Design I (L0834)		Recitation Section (large)	1	1	
Microsystems Technology (L0724)		Lecture	2	4	
Productivity Management (L0928)		Problem-based Learning	2	2	
Productivity Management (L0931)		Recitation Section (small)	1	1	
Feedback Control in Medical Technology	(L0664)	Lecture	2	3	
Renewable Energy (L0313)		Lecture	2	2	
Renewable Energy (L1434)		Recitation Section (small)	1	1	
Six Sigma (L1130)		Lecture	2	3	
System Analysis in Air Transportation (L0	855)	Lecture	3	3	
Technical Design (L1513)	,	Lecture	2	3	
Ceramics Technology (L0379)		Lecture	2	3	
Materials Testing (L0949)		Lecture	2	2	
Reliability in Engineering Dynamics (L0176	3)	Lecture	2	2	
Reliability in Engineering Dynamics (L1303		Recitation Section (small)	1	2	
Reliability of Aircraft Systems (L0749)	~,	Lecture	2	3	
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the followi	ing loarning results			
-	Alter taking part successionly, subtents have reached the following	ing learning results			
Professional Competence					
Knowledge	<ul> <li>Students are able to express their extended knowledge</li> </ul>	are and discuss the connection of different	special fields or apr	lication areas of prod	
	development, materials and production		r discuss the connection of different special fields of application areas of prod		
	<ul> <li>Students are qualified to connect different special fields</li> </ul>	with each other			
Skills					
China China	<ul> <li>Students can apply specialized solution strategies and r</li> </ul>	new scientific methods in selected areas			
	<ul> <li>Students are able to transfer learned skills to new and u</li> </ul>	nknown problems and can develop own sol	ution approaches		
		,			
Personal Competence					
Social Competence	-				
Autonomy					
Autonomy	Students are able to develop their knowledge and skills	by autonomous election of courses.			
Workload in Hours	Depends on choice of courses				
Credit points	6				
Assignment for the Following	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulsor	v		
			7		
Curricula	Product Development, Materials and Production: Specialisation				
	Product Development, Materials and Production: Specialisation	n waterials: Elective Compulsory			



000100 2100	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in	Independent Study Time 48, Study Time in Lecture 42
Hours	
Examination	Mündliche Prüfung
Form	
Examination	30 Minuten
duration	
and scale	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrated Production Systems	
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	<ul> <li>Lecture</li> <li>Objective and subjective perception for the evaluation of product characteristics</li> <li>Effects of material, color, shape and structure to the acceptance of a product</li> <li>Aesthetic function of a product</li> <li>Case studies, lack of acceptance of a product and possible reason</li> <li>Seminar</li> <li>Identification of non-technical product functions</li> <li>Identification of subjective influences for the product development</li> <li>Project Work</li> <li>Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated</li> <li>Exemplary Project: Holistic product evaluation, product optimization</li> </ul>
Literature	Wird in der Veranstaltung angegeben
	······································



Course L1512: Development Manag	gement for Mechatronics
• •	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>

Course L0310: Fatigue & Damage T	olerance
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,
	environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	
Content	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structu used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applicati is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwe structures as well as their application fields.
Literature	Lecture Nation and extend papers
	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> </ul>
	<ul> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> </ul>
	D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook
	D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1514: Lightweight Constru	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	Fundamentals of Anisotropic Elasticity
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law
	Behaviour of a single laminate layer
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules
	Fundamentals of Micromechanics of a laminate layer
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin
	Bending of Composite Laminated Plates
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions
	Stress Concentration Problems
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis
	Stability of Thin-Walled Composite Structures
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and thei evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> </ul>
	<ul> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	• Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.
	• Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.
	Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
	<ul> <li>getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>Determination of material properties based on sample tests</li> <li>manufacturing of the structure in the composite lab</li> <li>Testing of the developed structure</li> <li>Concept presentation</li> <li>Self-organised teamwork</li> </ul>
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	r Aircraft Applications
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements,
	thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	<ol> <li>Introduction/process of aircraft design/various aircraft configurations</li> <li>Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)</li> <li>Statistical methods in overall aircraft design/data base methods</li> <li>Principles of aircraft performance design (stability, V-n-diagramme)</li> <li>Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)</li> <li>Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)</li> <li>Principles of engine design and integration</li> <li>Cruise design</li> <li>Design of runway and landing field length</li> <li>Cabin design (fuselage dimensioning, cabin interior, loading systems)</li> <li>System- and equipment aspects</li> <li>Design variations and operating cost calculation</li> </ol>
Literature	J. Roskam: "Airplane Design" D.P. Raymer: "Aircraft Design - A Conceptual Approach" J.P. Fielding: "Intorduction to Aircraft Design" Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
-	
Тур	Recitation Section (large)
Hrs/wk	1
CP	
Workload in Hours	
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Prof. Hoc Khiem Trieu	
Language	EN	
Cycle	WiSe	
	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nance imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVE LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching wit KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitiv and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnet resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organi semiconductor gas</li></ul>	
	<ul> <li>microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhea microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics)</li> <li>MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrode cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration)</li> <li>Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM ar equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship)</li> <li>System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip ch bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; mic electroplating, 3D-MID)</li> </ul>	
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002	
	N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009	
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010	
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008	



Course L0928: Productivity Management		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>	
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985	

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Ulf Pilz, Prof. Olaf Simanski	
Language	DE	
Cycle	SoSe	
Content	Taking an engineering point of view, the lecture is structured as follows.	
	<ul> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/ rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.	
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart	
	Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag	
	M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000	



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul> Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L0855: System Analysis in Air Transportation	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>
Literature	Hand out

Course L1513: Technical Design	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Hausarbeit
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



SC	. "Product Development, Materials and Production"
	Literaturhinweise
	What is Product Design ?
	Laura Slack
	RotoVision Schweiz 2006
	Product Design Now
	Design and Scetches
	CollinsDesign and maomao publications Spanien 2006
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques
	for Designers, Illustrators and Architects,
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,
	New York 1983
	Creative Techniques
	DRAWING
	Barons Educational Series
	ISBN-13: 978-0-7641-6182-7
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept
	Presentation for Designers and Illustrators
	Watson-Guptil Publication a division of Billboard Publications Inc.,
	New York 1985
	AIRWORLD
	Design und Architektur für die Flugreise
	Vitra Design Stiftung Weil am Rhein 2004
	Airline Design
	Perter Deslius Jacek Slaski te Neues 2005
	Technik und Sicherheit von Passagierflugzeugen
	Frank Littek
	Motorbuch Verlag 2003
	Jetliner Cabins
	Jennifer Coutts Clay
	Cs books England 2006
	BOEING Widebodies
	Michael Haenggi motorbooks international USA 2003
	form - Zeitschrift für Gestaltung, Verlag form GmbH,
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim
	(erscheint vierteljährlich, Verlag form GmbH )
	design report
	german magasin,
	(erscheint monatlich)
	md - möbel interior design, Konradin-Verlag
	Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen
	(erscheint monatlich)
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,
	Kitashinjuku, Shinjuku-ku, Tokio 160, Japan
	(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courie
	Auto & Design,
	Corso Frabcia 161, 10139 Torino, Italia
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei

ier Service Deutschland GmbH,

Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technolog	у				
Тур	Lecture				
Hrs/wk	2				
CP	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Examination Form	lausur				
Examination duration and scale	90 Minuten				
	Dr. Rolf Janßen				
Language					
Cycle	WiSe				
Content	stroduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new evelopments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give ngineering students an understanding of technology development and specific applications of ceramic components.				
	Content: 1. Introduction				
	Inhalt: 2. Raw materials				
	3. Powder fabrication				
	4. Powder processing				
	5. Shape-forming processes				
	6. Densification, sintering				
	7. Glass and Cement technology				
	8. Ceramic-metal joining techniques				
Literature	W.D. Kingery, "Introduction to Ceramics", John Wiley & Sons, New York, 1975				
	SM Engineering Materials Handbook Vol.4 "Ceramics and Glasses", 1991				
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992				
	Skript zur Vorlesung				



Course L0949: Materials Testing			
Тур	Lecture		
Hrs/wk	2		
CP			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	90 Minuten		
Lecturer	Dr. Jan Oke Peters		
Language	DE		
Cycle	WiSe		
Content			
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>		
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill		

Course L0176: Reliability in Engineering Dynamics				
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	Klausur			
Examination duration and scale	90 min.			
Lecturer	Prof. Uwe Weltin			
Language	EN			
Cycle	SoSe			
	Method for calculation and testing of reliability of dynamic machine systems  Modeling  System identification  Simulation  Processing of measurement data Damage accumulation  Test planning and execution			
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 L1303: Reliability in Enginee	Course L1303: Reliability in Engineering Dynamics		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Examination Form	Klausur		
Examination duration and scale	90 min		
Lecturer	Prof. Uwe Weltin		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



ourse L0749: Reliability of Aircraft Systems			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	90 Minuten		
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>		
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>		



Module M1226: Mechanica	Properties			
	Flopenies			
Courses				
Title		Тур	Hrs/wk	CP
Mechanical Behaviour of Brittle Materials (	L1661)	Lecture	2	3
Dislocation Theory of Plasticity (L1662)		Lecture	2	3
Module Responsible	Dr. Erica Lilleodden			
Admission Requirements	None			
Recommended Previous	Basics in Materials Science I/II			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students can explain basic principles of crys	stallography, statics (free body diagrams, tractions)	and thermodynamics (ene	rgy minimization, ener
	barriers, entropy)			
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Personal Competence				
Social Competence	Students can provide appropriate feedback and	d handle feedback on their own performance construc	ctively.	
Autonomy	Students are able to			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific to	erms and to define further work steps on this basis gui	ided by teachers.	
	- work independently based on lectures and no	otes to solve problems, and to ask for help or clarificati	ons when needed	
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Materials Science: Core qualification: Compute	sory		
Curricula	Mechanical Engineering and Management: Sp	ecialisation Materials: Elective Compulsory		
	Product Development, Materials and Productio	n: Specialisation Product Development: Elective Com	pulsory	
	Product Development, Materials and Productio	n: Specialisation Production: Elective Compulsory		
	Product Development, Materials and Productio	n: Specialisation Materials: Compulsory		



Typ       Lecture         Hrawk       2         0       3         Workload in Hours       Independent Suly Time 82. Study Time in Lecture 28         Lecture       Piol. Cendol Schmeider         DEEN       Option         Cyce       SoSe         Content       Theoretical Strength         Content       Theoretical Strength         Content       Scattering of strength of brittle materials         Defect dystalline materials       Defect dystalline materials         Defect distribution, strength distribution, Webuil distribution       Heterogeneous materials         Defect distribution, strength distribution, Webuil distribution       Heterogeneous materials         University for strength of brittle materials       Defect distribution, strength distribution, Heterogeneous materials II         Toughening mechanisms: Crack bridging, fibres       Heterogeneous materials II         Toughening mechanisms: Crack bridging, fibres       Heterogeneous materials II         Toughening mechanisms: Crack bridging mechanisms       Process zone         Testing methods to determine the fracture toughness of brittle materials       Recurve, stable unstable crack growth, fractography         Thermal shock       Subcritical crack growth, fractography       Thermal shock         Subcritical crack growth, visce components       Example	Course L1661: Mechanical Behavior	ur of Brittle Materials	
Mraiwk       2         OP       3         Worklada In Hours       Independent Study Time 62. Study Time in Lecture 28         Lecturer       Port Garold Schneider         Language       DERN         Opteb       ScSo         Content       Theoretical Strength         Mainter Strength       Mainter Strength         Mainter Strength       Mainter Strength         Mainter Strength       Mainter Strength         Mainter Strength       Mainter Strength         Mainter Strength       Scattering of strength of brittle materials         Energy release reate, stress intensity factor, fracture criterion       Scattering of strength distribution, Weibuil distribution         Heterogeneous materials I       Internal stresses, micro cracks, weight function,         Heterogeneous materials II       Toughening mechanisms. Crack bridging, fibres         Heterogeneous materials II       Toughening mechanisms. Process zone         Testing methods to determine the fracture toughness of brittle materials       Recurve, stable/unstable crack growth, fractography         Thermal shock       Subcritical crack growth)       V: K-curve, files line prediction         Kriechen       Mechanical properties of biological materials       Raminterials         Literature       D: R H Jones, Michael F. Asithy, Engineering Materials 1. A	Тур	Lecture	
Workload in Hours         Independent Study Time is 2, Study Time in Lecture 28           Lecture         Prof. Gardid Schneider           Language         DEEN           Cycle         SoSe           Content         Theoretical Strength Of a perfect cystalline material, theoretical critical shear stress           Real strength of brittle materials         Energy release reade, stress infensity factor, fracture criterion           Scattering of strength of brittle materials         Defect distribution, weight distribution           Heterogeneous materials I         Interpretion and the strength of brittle materials           Defect distribution, stength of brittle materials         Defect distribution, stength distribution,           Heterogeneous materials II         Toughening mechanisms. crack bridging, fibres           Heterogeneous materials III         Toughening mechanisms. Process zone           Testing methods to determine the fracture toughness of britte materials         R-curve, stable/unstable crack growth, fractography           Thermal shock         Subcritical crack growth, view close store         Subcritical crack growth, weich close to biological materials           Examples of use for a mechanically reliable design of ceramic components         Examples of use for a mechanical properties of conspire; Cambridge University Press, 1993           D. Murz, T. Fet, Ceramics, Springer, 2001         Deriversity Press, 1993         D. Murz, T. Fet, Ceramics, Springer, 200	Hrs/wk	2	
Lecture         Prof. Geroid Schneider           Language         DEEN           Cycle         SoSe           Content         Theoretical Strength Of a portect crystalline material, theoretical critical shear stress           Real strength of brittle materials         Encry release reace, stress informity factor, fracture criterion           Scattering of strength of brittle materials         Detect distribution, strength distribution, Weibuil distribution           Heterogeneous materials I         Internal stresses, micro cracks, weight function,           Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres           Heterogeneous materials III         Toughening mechanisms. Process zone           Toughening mechanisms. Process zone         Testing methods to determine the fracture toughness of britte materials           R-curve, stable unstable crack growth, fractography         Thermal shock           Subcritical crack growth, vik-curve, life time prediction.         Kriechen           Mechanical properties of biological materials         Examples of use for a mechanically reliable design of caramic components           Literature         D R H Jones, Michael F. Ashty, Engineering Materials 1. An Introduction to Properties. Applications and Design, Elesevier           D.J. Crean, An introduction to the mechanical properties of cloaranics, Cambridge University Press, 1998         B.R. Lawn, Fracture of Britle Solids <sup>1</sup> , Cambridge University Press, 1993	CP	3	
Language       DEEN         Cycle       SisSe         Content       Theoretical Strength         Of a parfect crystalline material, theoretical critical shear stress         Real strength of brittle materials         Energy release reate, stress intensity factor, fracture criterion         Scattering of strength of brittle materials         Defect distribution, strength distribution, Weibuil distribution         Heterogeneous materials I         Internal stresses, micro cracks, weight function,         Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres         Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres         Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres         Relevageneous materials II         Toughening mechanisms: crack bridging, fibres         Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres         Recurve, stable/unstable crack growth, fractography         Thermal shock         Subcritical crack growth)         v: K-curve, life time prediction         Kriechen         Mechanicall properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Examples of use for a m	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
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Context       Theoretical Strength         Cf a perfect crystalline material, theoretical critical shear stress         Real strength of brittle materials         Energy release reate, stress intensity factor, fracture criterion         Scattering of strength of brittle materials         Defect distribution, strength distribution, Weibuil distribution         Heterogeneous materials I         Internal stresses, micro cracks, weight function,         Heterogeneous materials II         Toughening mechanisms: crack bridging, fibres         Heterogeneous materials II         Toughening mechanisms: crack growth, fractography         Thermal shock         Subcritical crack growth)         v-K-curve, life sime prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properfes, Applications and Design, Elsevier         D,J, Green, An introduction to the mechanical prope	Language	DE/EN	
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Toughening mechanisms. Process zone         Testing methods to determine the fracture toughness of brittle materials         R-curve, stable/unstable crack growth, fractography         Thermal shock         Subcritical crack growth)         v-K-curve, life time prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature         D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1998         D.Munz, T. Fett, Ceramics, Springer, 2001		l oughening mechanisms: crack bridging, fibres	
Testing methods to determine the fracture toughness of brittle materials         R-curve, stable/unstable crack growth, fractography         Thermal shock         Subcritical crack growth)         v-K-curve, life time prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		terogeneous materials III	
R-curve, stable/unstable crack growth, fractography         Thermal shock         Subcritical crack growth)         v-K-curve, life time prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		Jghening mechanisms. Process zone	
Thermal shock         Subcritical crack growth)         v-K-curve, life time prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		esting methods to determine the fracture toughness of brittle materials	
Subcritical crack growth)       v-K-curve, life time prediction         Kriechen       Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components       Examples of use for a mechanically reliable design of ceramics components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		R-curve, stable/unstable crack growth, fractography	
v-K-curve, life time prediction         Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		Thermal shock	
Kriechen         Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		Subcritical crack growth)	
Mechanical properties of biological materials         Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		v-K-curve, life time prediction	
Examples of use for a mechanically reliable design of ceramic components         Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		Kriechen	
Literature       D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier         D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998         B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993         D. Munz, T. Fett, Ceramics, Springer, 2001		Mechanical properties of biological materials	
<ul> <li>D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998</li> <li>B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993</li> <li>D. Munz, T. Fett, Ceramics, Springer, 2001</li> </ul>		Examples of use for a mechanically reliable design of ceramic components	
B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993 D. Munz, T. Fett, Ceramics, Springer, 2001	Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier	
D. Munz, T. Fett, Ceramics, Springer, 2001		D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998	
		B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993	
D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992		D. Munz, T. Fett, Ceramics, Springer, 2001	
		D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	

Course L1662: Dislocation Theory of Plasticity			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Erica Lilleodden		
Language	DE/EN		
Cycle	SoSe		
Content	This class will cover the principles of dislocation theory from a physical metallurgy perspective, providing a fundamental understanding of the relations between the strength and of crystalline solids and distributions of defects.		
	We will review the concept of dislocations, defining terminology used, and providing an overview of important concepts (e.g. linear elasticity, stress-strain relations, and stress transformations) for theory development. We will develop the theory of dislocation plasticity through derived stress-strain fields, associated self-energies, and the induced forces on dislocations due to internal and externally applied stresses. Dislocation structure will be discussed, including core models, stacking faults, and dislocation arrays (including grain boundary descriptions). Mechanisms of dislocation multiplication and strengthening will be covered along with general principles of creep and strain rate sensitivity. Final topics will include non-FCC dislocations, emphasizing the differences in structure and corresponding implications on dislocation mobility and macroscopic mechanical behavior; and dislocations in finite volumes.		
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen		



Module M0840: Optimal and F	obust Control			
Courses				
litle		Тур	Hrs/wk	CP
Optimal and Robust Control (L0658)		Lecture	2	3
Dptimal and Robust Control (L0659)		Recitation Section (small)	2	3
Module Responsible Pr	of. Herbert Werner			
Admission Requirements No	ne			
Recommended Previous				
Knowledge	Classical control (frequency response, root locus)			
	<ul><li>State space methods</li><li>Linear algebra, singular value decomposition</li></ul>			
	Linear algebra, singular value decomposition			
Educational Objectives Af	er taking part successfully, students have reached the follow	ng learning results		
Professional Competence				
Knowledge	Ctudents con explain the significance of the metrix Disc.	ati aquation for the colution of LO problem	-	
	<ul> <li>Students can explain the significance of the matrix Ricc.</li> <li>They can explain the duality between optimal state feed</li> </ul>		5.	
	<ul> <li>They can explain the duality between optimal state leed</li> <li>They can explain how the H2 and H-infinity norms are u</li> </ul>		constraints	
	<ul> <li>They can explain how are right and right mining norms are a</li> <li>They can explain how an LQG design problem can be for</li> </ul>			
	<ul> <li>They can explain how an Edd design problem can be repres</li> </ul>			
	They can explain how - based on the small gain theorem			an uncertain plant.
	<ul> <li>They understand how analysis and synthesis conditions</li> </ul>			
Skills	Students are capable of designing and tuning LQG cont	rollers for multivariable plant models.		
	They are capable of representing a H2 or H-infinity de		I plant, and of using sta	Indard software tools
	solving it.			
	• They are capable of translating time and frequency do	main specifications for control loops into	constraints on closed-lo	pop sensitivity functio
	and of carrying out a mixed-sensitivity design.			
	They are capable of constructing an LFT uncertainty mo	del for an uncertain system, and of design	ing a mixed-objective re	obust controller.
	They are capable of formulating analysis and synthes	is conditions as linear matrix inequalitie	s (LMI), and of using s	standard LMI-solvers
	solving them.			
	They can carry out all of the above using standard softw	are tools (Matlab robust control toolbox).		
Personal Competence				
	udents can work in small groups on specific problems to arriv	e at joint solutions.		
	udents are able to find required information in sources provid		imentation) and use it to	solve given problem
-			,	0 1
Workload in Hours Ind	dependent Study Time 124, Study Time in Lecture 56			
Credit points 6				
Examination Or	al exam			
Examination duration and scale 30	min			
	omputer Science: Specialisation Intelligence Engineering: Ele			
	ectrical Engineering: Specialisation Control and Power Syste	ms: Elective Compulsory		
	ergy Systems: Core qualification: Elective Compulsory			
	craft Systems Engineering: Specialisation Aircraft Systems: E			
	omputational Science and Engineering: Specialisation System		mpulsory	
	echatronics: Specialisation Intelligent Systems and Robotics:			
	echatronics: Specialisation System Design: Elective Compuls		<i>n</i> /	
	omedical Engineering: Specialisation Artificial Organs and Re		r y	
	omedical Engineering: Specialisation Implants and Endopros			
	omedical Engineering: Specialisation Medical Technology ar omedical Engineering: Specialisation Management and Busi			
	oduct Development, Materials and Production: Specialisation			
			UT y	
Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory				
	eoretical Mechanical Engineering: Technical Complementar	Course: Elective Compulsorv		



Course L0658: Optimal and Robust	Control
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	<ul> <li>Optimal regulator problem with finite time horizon, Riccati differential equation</li> <li>Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system</li> <li>Kalman's identity, phase margin of LQR controllers, spectral factorization</li> <li>Optimal state estimation, Kalman filter, LQG control</li> <li>Generalized plant, review of LQG control</li> <li>Signal and system norms, computing H2 and H∞ norms</li> <li>Singular value plots, input and output directions</li> <li>Mixed sensitivity design, H∞ loop shaping, choice of weighting filters</li> <li>Case study: design example flight control</li> <li>Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region)</li> <li>Controller synthesis by solving LMI problems, multi-objective design</li> <li>Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes: "Optimale und Robuste Regelung"</li> <li>Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994</li> <li>Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996</li> <li>Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988</li> <li>Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998</li> </ul>

Course L0659: Optimal and Robust Control		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1344: Processing	of fibre-polymer-composites			
0				
Courses		<b>T</b>	Due to de	0.5
Title	14005	Typ Lecture	Hrs/wk 2	CP
Processing of fibre-polymer-composites ( From Molecule to Composites Part (L1516		Problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler		-	C C
Admission Requirements	None			
Recommended Previous	Structure and Properties of Polymers			
Knowledge	Structure and Properties of Composites			
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 the manufacturing processes composites	and illustrate respectiv	e relationships. They are
	capable of describing and communicating relevant p	roblems and questions using appropriate technical	language. They can ex	plain the typical process
	of solving practical problems and present related res	ults.		
Skills	The students can transfer their fundamental knowle	dae on civil engineering to the process of solving p	ractical problems. The	ev identify and overcome
	typical problems during the realization of projects in			
	solutions for non-standardized problems.			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-su	bject groups in order to independently derive solu	tions to given probler	ns in the context of civi
	engineering. They are able to effectively present and	I explain their results alone or in groups in front of a	qualified audience. St	udents have the ability to
	develop alternative approaches to an engineering pr	oblem independently or in groups and discuss adva	ntages as well as draw	backs.
Autonomy	Students are capable of independently solving mech	anical engineering problems using provided literatu	re. They are able to fill	gaps in as well as extent
	their knowledge using the literature and other sour	rces provided by the supervisor. Furthermore, they	can meaningfully exte	end given problems and
	pragmatically solve them by means of corresponding	solutions and concepts.		
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	Materials Science: Specialisation Engineering Mater	als: Elective Compulsory		
Curricula	Mechanical Engineering and Management: Specialis	ation Materials: Elective Compulsory		
	Product Development, Materials and Production: Spe	cialisation Product Development: Elective Compulse	ory	
	Product Development, Materials and Production: Spe	ecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Spe	cialisation Materials: Elective Compulsory		

Course L1895: Processing of fibre-polymer-composites			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Bodo Fiedler		
Language	DE/EN		
Cycle	SoSe		
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding		
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall		

Course L1516: From Molecule to Composites Part				
Тур	Problem-based Learning			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Bodo Fiedler			
Language	DE/EN			
Cycle	SoSe			
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task			
	technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective documents (electronically and in conversation). The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made handlebar with approved quality. In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of the final report created (compilation of the results for the "customers"). After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous improvement.			
Literature	Customer Request ("Handout")			



Module M1343: Fibre-polym	er-composites					
Courses						
Title		Тур	Hrs/wk	CP		
Structure and properties of fibre-polymer-composites (L1894)		Lecture	2	3		
Design with fibre-polymer-composites (L1893)		Lecture	2	3		
Module Responsible	Prof. Bodo Fiedler					
Admission Requirements	None					
Recommended Previous	Basics: chemistry / physics / materials science					
Knowledge						
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results				
Professional Competence						
Knowledge	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents to play (fiber / matrix) and define the necessar					
	testing and analysis.					
	They can explain the complex relationships structure-pro	perty relationship and				
	They can explain the complex relationships structure-property relationship and					
	the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain ne					
	(e.g. sustainability, environmental protection).					
Skills	Students are capable of					
	- using standardized calculation methods in a given of	ontext to mechanical properties (mo	dulus strength) to calcu	ilate and evaluate the		
	- using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and different materials.					
	- Approximate sizing using the network theory of the structural elements implement and evaluate.					
	- For mechanical recycling problems selecting appropriate solutions and sizing example Stiffness, corrosion resistance.					
Personal Competence						
Social Competence						
	- arrive at work results in groups and document them.					
	- provide appropriate feedback and handle feedback on their own performance constructively.					
Autonomy						
	anness their own strengths and westmanness					
	<ul> <li>- assess their own strengths and weaknesses</li> <li>- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.</li> <li>- assess possible consequences of their professional activity.</li> </ul>					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	ivity.				
Credit points	6					
Examination	Written exam					
Examination duration and scale	180 min					
	Energy Systems: Core qualification: Elective Compulsory					
	Aircraft Systems Engineering: Specialisation Cabin Systems:	Elective Compulsory				
	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory					
	Materials Science: Specialisation Engineering Materials: Ele	ctive Compulsory				
	Mechanical Engineering and Management: Core qualificatio	n: Compulsory				
	Product Development, Materials and Production: Specialisati	on Product Development: Elective Comp	oulsory			
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory					
	Product Development, Materials and Production: Specialisati					
	Renewable Energies: Specialisation Bioenergy Systems: Ele					
	Renewable Energies: Specialisation Solar Energy Systems:					
	Renewable Energies: Specialisation Wind Energy Systems:					
	Theoretical Mechanical Engineering: Specialisation Material	s Science: Elective Compulsory				



Course L1894: Structure and properties of fibre-polymer-composites		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	SoSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction	
	- Development of composite materials	
	- Mechanical and physical properties	
	- Mechanics of Composite Materials	
	- Laminate theory	
	- Test methods	
	- Non destructive testing	
	- Failure mechanisms	
	- Theoretical models for the prediction of properties	
	- Application	
Literature		
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press	
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L1893: Design with fibre-polymer-composites		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	SoSe	
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques;	
	Compression Loading; Examples	
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Module M0563: Robotics				
Courses				
		To and	Hus fords	0.5
Title		Тур	Hrs/wk	CP
Robotics: Modelling and Control (L0168) Robotics: Modelling and Control (L1305)		Lecture Recitation Section (small)	3 2	3 3
Module Responsible	Prof. Uwe Weltin	ricolation occition (small)	L	5
Admission Requirements	None			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Broad knowledge of mechanics			
	Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties of robots an	d solution approaches for multiple proble	ms in robotics.	
Skills	Students are able to derive and solve equations of motion for vario	us manipulators.		
	Students can generate trajectories in various coordinate systems.			
	Students can design linear and partially nonlinear controllers for re-	obotic manipulators.		
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 in	dependently.		
	With instructor assistance, students are able to evaluate their own	knowledge level and define a further cou	irse of study.	
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	Computer Science: Specialisation Intelligence Engineering: Electi	ve Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Electronic Systems (Second Systems) (Second S	ctive Compulsory		
	Computational Science and Engineering: Specialisation Systems	Engineering and Robotics: Elective Com	pulsory	
	International Production Management: Specialisation Production	echnology: Elective Compulsory		
	International Management and Engineering: Specialisation II. Med	hatronics: Elective Compulsory		
	International Management and Engineering: Specialisation II. Proc	duct Development and Production: Electiv	ve Compulsory	
	Mechanical Engineering and Management: Core qualification: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation Production:	oduct Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation Production:	oduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation M	aterials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Deve		llsory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		

Course L0168: Robotics: Modelling and Control		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Uwe Weltin	
Language	EN	
Cycle	WiSe	
Content	Fundamental kinematics of rigid body systems	
	Newton-Euler equations for manipulators	
	Trajectory generation	
	Linear and nonlinear control of robots	
Literature	Craig, John J.: Introduction to Robotics Mechanics and Control, Third Edition, Prentice Hall. ISBN 0201-54361-3	
	Spong, Mark W.; Hutchinson, Seth; Vidyasagar, M. : Robot Modeling and Control. WILEY. ISBN 0-471-64990-2	



Course L1305: Robotics: Modelling	Course L1305: Robotics: Modelling and Control	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Uwe Weltin	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0771: Flight Phys	ics			
Courses				
Title		Тур	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L07	797)	Lecture	3	3
Flight Mechanics II (L0730)	21)	Lecture	2	2
Flight Mechanics II (L0731)		Recitation Section (large)	1	- 1
Module Responsible	Prof. Frank Thielecke			
	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Ŭ			
Ŭ	Mathematics			
	Mechanics			
	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the follow	wing 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 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory			
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory			
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory			
	Product Development, Materials and Production: Specialisation	on Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft S	ystems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementa	ary Course: Elective Compulsory		
		, etc. Elocaro compatori,		

Course L0727: Aerodynamics and F	Flight Mechanics I
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Ralf Heinrich, Mike Montel
Language	DE
Cycle	WiSe
Content	<ul> <li>Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows)</li> <li>Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)</li> </ul>
Literature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>



Course L0730: Flight Mechanics II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	<ul> <li>stationary asymmetric flight</li> <li>dynamics of lateral movement</li> <li>methods of flight simulation</li> <li>eyperimental methods of flight mechanics</li> <li>model validation using system identification</li> <li>wind tunnel techniques</li> </ul>
Literature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>

Course L0731: Flight Mechanics II	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0815: Product Pla	anning			
Courses				
Title		Тур	Hrs/wk	CP
Product Planning (L0851)		Problem-based Learning	3	3
Product Planning Seminar (L0853)		Problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt	0		
Admission Requirements	None			
Recommended Previous	Good basic-knowledge of Business Administration			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learn	na results		
Professional Competence	······································			
Knowledge	Students will gain insights into:			
hitowiedge				
	Product Planning			
	<ul> <li>Process</li> </ul>			
	<ul> <li>Methods</li> </ul>			
	Design thinking			
	<ul> <li>Process</li> </ul>			
	<ul> <li>Methods</li> </ul>			
	<ul> <li>User integration</li> </ul>			
Skills	Students will gain deep insights into:			
	Product Planning			
	<ul> <li>Process-related aspects</li> </ul>			
	<ul> <li>Organisational-related aspects</li> </ul>			
	<ul> <li>Human-Ressource related aspects</li> </ul>			
	<ul> <li>Working-tools, methods and instruments</li> </ul>			
	0			
<b>D</b>				
Personal Competence				
Social Competence	<ul> <li>Interact within a team</li> </ul>			
	<ul> <li>Raise awareness for globabl issues</li> </ul>			
Autonomy	<ul> <li>Gain access to knowledge sources</li> </ul>			
	Interpret complex cases			
	Develop presentation skills			
· · · · · · · · · · · · · · · · · · ·				
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	Global Innovation Management: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation I. Electives			
	Mechanical Engineering and Management: Specialisation Managemen			
	Product Development, Materials and Production: Specialisation Product		y	
	Product Development, Materials and Production: Specialisation Product			
	Product Development, Materials and Production: Specialisation Materia			
	Theoretical Mechanical Engineering: Specialisation Product Developme		lsory	
	Theoretical Mechanical Engineering: Technical Complementary Course	: Elective Compulsory		

Course L0851: Product Planning	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process
	This integrated lecture is designed to understand major issues, activities and tools in the context of systematic product planning, a key activity for managing the front-end of innovation, i.e.:
	Systematic scanning of markets for innovation opportunities
	Understanding strengths/weakness and specific core competences of a firm as platforms for innovation
	<ul> <li>Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.)</li> <li>Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment</li> <li>Transferring ideas for innovation into feasible concepts which have a high market attractively</li> </ul>
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010



Course L0853: Product Planning Seminar		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Cornelius Herstatt	
Language	EN	
Cycle	WiSe	
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly	
Literature	see/siehe Vorlesung Produktplanung/Product Planning	



Module M0830: Environme	ntal Protection and Management			
Courses				
Title		True	Hrs/wk	CP
Integrated Pollution Control (L0502)		Typ Lecture	2	2
Health, Safety and Environmental Manage	ment (I 0387)	Lecture	2	3
Health, Safety and Environmental Manage		Recitation Section (small)	- 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous				
Knowledge	Good knowledge in Technologies for Environmental I			
	Good knowledge of the relevant Environmental Legis     Bosis knowledge of instruments for Environmental As			
	<ul> <li>Basic knowledge of instruments for Environmental As</li> </ul>	sessment		
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	The students are able to describe the basics of regulations	s, economic instruments, voluntary initiatives,	fundamentals of HS	E legislation ISO 14001
	EMAS and Responsible Care ISO 14001 requirements. They	can analyse and discuss industrial processes	s, substance cycles a	nd approaches from end
	of-pipe technology to eco-efficiency and eco-effectiveness, si	howing their sound knowledge of complex ind	ustry related problem	ns. They are able to judge
	environmental issues and to widely consider, apply or carry of		measures and furthe	er interventions as well a
	conceptual problem solving approaches in the full range of p	roblems in different industrial sectors.		
Skills	Students are able to assess current problems and situation	s in the field of environmental protection. The	y can consider the b	oest available technique
	and to plan and suggest concrete actions in a company- or b	ranch-specific context. By this means they can	solve problems on a	a technical, administrativ
	and legislative level.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare then	nselves for presentations and contributions to t	he discussions. The	y can acquire appropriate
	knowledge by making enquiries independently.			
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	90 min Energy and Environmental Engineering: Specialisation Envir	ronmontal Engineering: Elective Computer		
Assignment for the Following Curricula	Energy and Environmental Engineering: Specialisation Environmental Engineering: Core qualification: Compulsory	connental Engineering: Elective Compulsory		
Gurneula	Joint European Master in Environmental Studies - Cities and	Sustainability: Specialisation Water: Elective (	Compulsory	
	Joint European Master in Environmental Studies - Cities and			
	Product Development, Materials and Production: Specialisati			
	Product Development, Materials and Production: Specialisati		J	
	Product Development, Materials and Production: Specialisati			
	Water and Environmental Engineering: Specialisation Enviro			
	Water and Environmental Engineering: Specialisation Enviro			
	Maior and Environmental Engineering. Opecialisation Offies.	. compaisory		



Course L0502: Integrated Pollution	Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	<ul> <li>The Regulatory Framework</li> <li>Pollution &amp; Impacts, Characteristics of Pollutants</li> <li>Approaches of Integrated Pollution Control</li> <li>Sevilla Process, Best Available Technologies &amp; BREF Documents</li> <li>Case Studies: paper industry, cement industry, automotive industry</li> <li>Field Trip</li> </ul>
Literature	Shen, Thomas T. (1999): Industrial Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-542-80313-0

Course L0387: Health, Safety and E	nvironmental Management
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

Course L0388: Health, Safety and E	purse L0388: Health, Safety and Environmental Management	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hans-Joachim Nau	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0867: Production	Planning & Control and Digital Ente	erprise		
Courses				
Title		Тур	Hrs/wk	CP
The Digital Enterprise (L0932)		Lecture	2	2
Production Planning and Control (L0929)		Lecture	2	2
Production Planning and Control (L0930)		Recitation Section (small)	1	1
Exercise: The Digital Enterprise (L0933)		Recitation Section (small)	1	1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous	Fundamentals of Production and Quality Manage	ement		
Knowledge				
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module	in detail and take a critical position to them.		
Skills	Students are capable of choosing and applying r	models and methods from the module to industrial probl	ems.	
Personal Competence				
Social Competence	Students can develop joint solutions in mixed tea	ams and present them to others.		
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ıre 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following	International Management and Engineering: Spe	ecialisation II. Product Development and Production: Ele	ctive Compulsory	
Curricula	Logistics, Infrastructure and Mobility: Specialisati	on Production and Logistics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial	Organs and Regenerative Medicine: Elective Compulso	ory	
	Biomedical Engineering: Specialisation Implants	and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical	Technology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manage	ment and Business Administration: Compulsory		
	Product Development, Materials and Production:	Specialisation Product Development: Elective Compute	sory	
	Product Development, Materials and Production:	Specialisation Production: Compulsory		
	Product Development, Materials and Production:	Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisat	tion Product Development and Production: Elective Con	npulsory	
	Theoretical Mechanical Engineering: Technical	Complementary Course: Elective Compulsory		

Course L0932: The Digital Enterpris	e
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, AW.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006



Course L0929: Production Planning	and Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	<ul> <li>Models of Production and Inventory Management</li> <li>Production Programme Planning and Lot Sizing</li> <li>Order and Capacity Scheduling</li> <li>Selected Strategies of PPC</li> <li>Manufacturing Control</li> <li>Production Controlling</li> <li>Supply Chain Management</li> </ul>
Literature	<ul> <li>Vorlesungsskript</li> <li>Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008</li> <li>Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002</li> </ul>

Course L0930: Production Planning and Control	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0933: Exercise: The Digita	Course L0933: Exercise: The Digital Enterprise	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Axel Friedewald	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	Siehe korrespondierende Vorlesung	
	See interlocking course	



Module M0962: Sustainabil	ity and Risk Management			
Courses				
Title		Тур	Hrs/wk	CP
Safety, Reliability and Risk Assessment (L	.1145)	Seminar	2	3
Environment and Sustainability (L0319)		Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students are able to describe single techniques and to give	e an overview for the field of safety a	und risk assessment as we	II as environmental and
	sustainable engineering, in detail:			
	<ul> <li>basics in safety and reliability of technical facilities</li> </ul>			
	<ul> <li>safety and reliability analysis methods</li> </ul>			
	risk assessment			
	Production and usage of bio-char			
	<ul> <li>energy production and supply</li> <li>sustainable product design</li> </ul>			
Skills	Students are able apply interdisciplinary system-oriented m costs for processes and select economically feasible treatmen		nability reporting. They car	evaluate the effort and
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from giver	n sources and transform it to new ques	tions. Furthermore, they ca	n define targets for new
	application or research-oriented duties in for risk manageme	ent and sustainability concepts accorda	nce with the potential socia	I, economic and cultural
	impact.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minutes in groups)			
Assignment for the Following	Civil Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II.	. Civil Engineering: Elective Compulson	/	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Water and Environmental Engineering: Core qualification: Co			
	trater and Environmental Engineering. Oore qualification. Ou			

Course L1145: Safety, Reliability an	d Risk Assessment
Тур	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski
Language	DE
Cycle	WiSe
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: <ul> <li>basics in safety and reliability of technical facilities</li> <li>safety and reliability analysis methods</li> <li>risk assessment</li> <li>practical examples and excursions</li> <li>discussions and presentations</li> </ul>
Literature	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>



Course L0319: Environment and Su	stainability
	Lecture
Hrs/wk	
CP	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Kerstin Kuchta
Language	EN
Cycle	
Content	
	energy supply, product design, water supply, waste water treatment or mobility. The following list show examples.
	Production and Usage of Bio-char
	Engergy production with algae
	Environmental product design
	Clean Development mechanism (CDM)
	Democracy and Energy
	New Concepts for a sustainable Energy Supply
	Recycling of Wind Turbines
	Alternative Mobility
	Disposal of Nuclear Wastes
	Waste2Energy
	Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.



Module M1002: Production	and Logistics Management			
Courses				
litle		Тур	Hrs/wk	CP
Operative Production and Logistics Manag	ement (L1198)	Lecture	2	2
Strategic Production and Logistics Manage		Problem-based Learning	3	4
Module Responsible	Prof. Wolfgang Kersten			
Admission Requirements	None			
Recommended Previous	Introduction to Business and Management			
Knowledge				
	The previous knowledge, that is necessary for the successful p	participation in this module is accessable vi	a a learning. Log in a	nd additional informat
	will be distributed during the admission process.		a e-leanning. Log-in a	
	win be distributed during the duringsion process.			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students will be able			
	- to differentiate between strategic and operational production	and logistics management,		
	- to describe the areas of production and logistics manageme			
	- understand the difference between traditional and new conc			
	- to describe and explain the actual challenges of production	and logistics management, esp. in an interr	ational context.	
Skills				
	Based on the acquired knowledge students are capable of			
	- Applying methods of production and logistics management i	n an international context,		
	- Selecting sufficient methods of production and logistics man	agement to solve practical problems,		
	- Selecting appropriate methods of production and logistics m	anagement also for non-standardized prob	lems,	
	- Making a holistic assessment of areas of decision in product	tion and logistics management and relevan	t influence factors.	
Personal Competence				
Social Competence	After completion of the module students can			
	- lead discussions and team sessions,			
	- arrive at work results in groups and document them,			
	- develop joint solutions in mixed teams and present them to o	others,		
A	- present solutions to specialists and develop ideas further.			
Autonomy	After completion of the module students can			
	- assess possible consequences of their professional activity,			
	- define tasks independently, acquire the requisite knowledge a	and use suitable means of implementation		
	come tasks independently, acquire the requisite kilowiedge a			
	- define and carry out research tasks bearing in mind possible s	societal consequences.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	International Management and Engineering: Core qualification	Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Compu			
Guilloula	Product Development, Materials and Production: Specialisation		ry	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			



Course L1198: Operative Production and Logistics Management				
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Thorsten Blecker			
Language	DE			
Cycle	WiSe			
Content	Further knowledge of operational production management			
	Traditional production planning and control concepts			
	<ul> <li>Recent production planning and control concepts</li> <li>Understanding and application of quantitative methods</li> </ul>			
	Further concepts regarding operational production management			
Literature				
	Corsten, H.: Produktionswirtschaft: Einführung in das industrielle Produktionsmanagement, 12. Aufl., München 2009.			
	Dyckhoff, H./Spengler T.: Produktionswirtschaft: Eine Einführung, 3. Aufl., Berlin Heidelberg 2010.			
	Heizer, J/Render, B: Operations Management, 10. Auflage, Upper Saddle River 2011.			
	Kaluza, B./Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in Virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.			
	Kaluza, B./Blecker, Th. (Hrsg.): Erfolgsfaktor Flexibilität. Strategien und Konzepte für wandlungsfähige Unternehmen, Berlin 2005.			
	Kurbel, K.: Produktionsplanung und steuerung, 5., Aufl., München - Wien 2003.			
	Schweitzer, M.: Industriebetriebslehre, 2. Auflage, München 1994.			
	Thonemann, Ulrich (2005): Operations Management, 2. Aufl., München 2010.			
	Zahn, E./Schmid, U.: Produktionswirtschaft I: Grundlagen und operatives Produktionsmanagement, Stuttgart 1996			
	Zäpfel, G.: Grundzüge des Produktions- und Logistikmanagement, 2. Aufl., München - Wien 2001			



capacity strategy) of a company         Evaluation of operation strategies of different companies and industrial sectors         In depth discussion of methods and concepts of production and logistics management         In depth discussion of lean management: Main goals and measures of lean management and lean production concepts, impact of management on production strategy         Presentation and discussion of current research topics in the field of production and logistics management         Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills         Literature       Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung in das industrielle Produktionsmanagement, 12. Auflage, München: Oldenbour Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.         Heizer, J./Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.         Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.	Тур	Problem-based Learning
Workload in Hours         Independent Study Time 78, Study Time in Lecture 42           Lecturer         Prof. Wolfgang Kersten           Language         DE           Cycle         WiSe           Content         Identification of the scope of production, operations and logistics management.           Understanding of actual challenges concerning production and logistics strategy.         Understanding operations as a competitive weapon           Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategies of different companies and industrial sectors           In depth discussion of methods and concepts of production and logistics management.           In depth discussion of problem strategies of different companies and industrial sectors           In depth discussion of problem strategy.           Presentation and discussion of current research topics in the field of production and logistics management.           Integration of Problem-Based-Learning sessions in order to enhance tearmorking and problem solving skills as well as presentation skills           Literature         Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.           Heizer, J./Render, B (2011): Operations Management for engineers, Oxford: Butterworth: Heinemann.           Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Vet Slack, N	Hrs/wk	3
Lecture         Prof. Woltgang Karsten           Language         DE           Cycle         Wise           Content         Identification of the scope of production, operations and logistics management           Understanding of actual challenges concerning production and logistics strategy         Understanding of actual challenges concerning production and logistics strategy           Understanding of actual challenges concerning production and logistics strategy         Understanding of actual challenges concerning production and logistics strategy           Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategakity strategy) of a company         Evaluation of operation strategies of different companies and industrial sectors           In depth discussion of them management.         In depth discussion of term management. Main goals and meaguement         In depth discussion of current research topics in the field of production and logistics management.           Integration of Problem Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills           Literature         Corsten, H. (Gössinger, R. (2009): Produktionswirtschaft – Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg (u.a.): Springer.           Heizer, J.Render, B (2011): Operations Management to engineers, Oxford: Butterworth-Heinemann.           Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, FrankturtMain [u.a.]: Campus-Vet Slack,	CP	4
Language       DE         Cycle       WiSe         Content <ul> <li>Identification of the scope of production, operations and logistics management.</li> <li>Understanding operations as a competitive weapon.</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strat capacity strategy) of a company.</li> <li>Evaluation of operation strategies of different companies and industrial sectors.</li> <li>In depth discussion of methods and concepts of production and logistics management.</li> <li>In depth discussion of team management. Main goals and measures of lean management and lean production concepts, impact of management on production strategy.</li> <li>Presentation and discussion of current research topics in the field of production and logistics management.</li> <li>Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills</li> <li>Literature</li> <li>Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – eine Einführung in das industrielle Produktionsmanagement, 12. Auflage, München: Oldenbou Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg (u.a.): Springer.</li> <li>Heizer, J./Render, B (2011): Operations Management for engineers, Oxford: Buterworth-Heinemann.</li> <li>Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Ver Stack, N./Lewis, M.(2002): Operations Strategy, Harlow u.a.</li> <li>Swink, M./ Meinyk, S./ Cooper. M./ Hartley, J(2011): Managing Operations across the Supply Chain, New York u.a.</li> <li>Wortmann, J. C. (1992): Production management systems for o</li></ul>	Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Ope         WiSe           Content         Identification of the scope of production, operations and logistics management.           Understanding of actual challenges concerning production and logistics strategy.         Understanding operations as a competitive weapon           Identification of operation strategies of different companies and industrial sectors         Identification of operation strategies of different companies and industrial sectors           In depth discussion of methods and concepts of production and logistics management         In depth discussion of the main element: Main goals and measures of lean management and lean production concepts, impact of management on production strategy           Presentation and discussion of current research topics in the field of production and logistics management         Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills           Literature         Corsten, H./Gössinger, R. (2009): Produktionswirtschaft – Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg (u.a.): Springer.           Heizer, J./Render, B. (2011): Operations Management, 10. Auflage, Upper Saddle River.           Heizer, J., Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Frankfurt/Main (u.a.): Campus-Vei Slack, N / Lewis, M.(2002): Operations Management, 10. Auflage, Upper Saddle River.           Heizer, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main (u.a.): Campus-Vei Slack, N / Lewis, M.(2002): Operations Strategy, Harlow u.a. <tr< td=""><td>Lecturer</td><td>Prof. Wolfgang Kersten</td></tr<>	Lecturer	Prof. Wolfgang Kersten
Content <ul> <li>Identification of the scope of production, operations and logistics management</li> <li>Understanding of actual challenges concerning production and logistics strategy</li> <li>Understanding operations as a competitive weapon</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategapisty strategy) of a company</li> <li>Evaluation of operation strategies of different companies and industrial sectors</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of current research topics in the field of production and logistics management</li> <li>In depth discussion of current research topics in the field of production and positiss management</li> <li>In tegration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills</li> </ul> <li>Literature</li> <li>Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung in das industrielle Produktionsmanagement, 12. Auflage, München: Oldenbou Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.</li> <li>Heizer, J./Render, B (2011): Operations Management for engineers, Oxford: Butterworth-Heinemann.</li> <li>Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Vei Slack, N/ Lewis, M.(2002): Operations Strategy, Harlow u.a.</li> <li>Swink, M./ Meinkyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a.</li> <li>Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Com</li>	Language	DE
<ul> <li>Identification of the scope of production, operations and logistics management</li> <li>Understanding of actual challenges concerning production and logistics strategy</li> <li>Understanding operations as a competitive weapon</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategacity strategy) of a company</li> <li>Evaluation of operation strategies of different companies and industrial sectors</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of lean management: Main goals and measures of lean management and lean production concepts, impact of management on production strategy</li> <li>Presentation and discussion of current research topics in the field of production and logistics management</li> <li>Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills</li> </ul> Literature Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg (u.a.): Springer. Heizer, J.Render, B (2011): Operations Management for engineers, Oxford: Butterworth-Heinemann. Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankturt/Main [u.a.]: Campus-Vei Slack, N/ Lewis, M.(2002): Operations Strategy, Harlow u.a. Swink, M./ Meinyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a. Womack, J./ Lewis, D./ Roos, D. (1990): The Machine that changed the world; New York. Zahn, E. (2016): Grundlager und operatives Produktionsmanagement, Stutgart: Lucius & Lucius	Cycle	WiSe
<ul> <li>Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.</li> <li>Heizer, J./Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.</li> <li>Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.</li> <li>Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Vet Slack, N./ Lewis, M.(2002): Operations Strategy, Harlow u.a.</li> <li>Swink, M./ Melnyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a.</li> <li>Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Computers in Industry 19, S. 79-88</li> <li>Womack, J./ Jones, D./ Roos, D. (1990): The Machine that changed the world; New York.</li> <li>Zahn, E. /Schmid, U. (1996): Grundlagen und operatives Produktionsmanagement, Stuttgart: Lucius &amp; Lucius</li> </ul>	Content	<ul> <li>Understanding of actual challenges concerning production and logistics strategy</li> <li>Understanding operations as a competitive weapon</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategy capacity strategy) of a company</li> <li>Evaluation of operation strategies of different companies and industrial sectors</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of lean management: Main goals and measures of lean management and lean production concepts, impact of lear management on production strategy</li> <li>Presentation and discussion of current research topics in the field of production and logistics management</li> </ul>
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		Zäpfel, G.(2000): Produktionswirtschaft: Strategisches Produktions-Management, 2. Aufl., München u.a.



Module M1155: Aircraft Cal	oin Systems			
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and cabin			
	explain the functional and non-functional requirements for ca			
	elucidate the necessity of cabin operating systems and emerged			
	assess the challenges human factors integration in a cabin e	nvironment		
Skills	Students are able to:			
	<ul> <li>design a cabin layout for a given business model of an Airling</li> </ul>			
	design cabin systems for safe operations			
	<ul> <li>design emergency systems for safe man-machine interaction</li> </ul>			
	<ul> <li>solve comfort needs and entertainment requirements in the c</li> </ul>			
Personal Competence				
Social Competence	Students are able to:			
	understand existing system solutions and discuss their ideas	with experts		
Autonomy	Students are able to:			
<i>Natonomy</i>	Reflect the contents of lectures and expert presentations self-	dependent		
	· · · · · · · · · · · · · · · · · · ·			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Elective Con	npulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory			
	International Management and Engineering: Specialisation II.	Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisatio	n Product Development: Elective Compulsor	У	
	Product Development, Materials and Production: Specialisatio	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisatio	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy	stems Engineering: Elective Compulsory		
		ry Course: Elective Compulsory		



Course L1545: Aircraft Cabin Syste	ms		
Тур	Lecture		
Hrs/wk	Hrs/wk 3		
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	WiSe		
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved.		
	The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion		
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999</li> <li>Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014</li> <li>Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008</li> <li>Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003</li> <li>Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006</li> <li>Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006</li> </ul>		

Course L1546: Aircraft Cabin Syste	ourse L1546: Aircraft Cabin Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Nodule M1174: Automation	n Technology and Systems			
Courses				
Title		True	Hrs/wk	CP
		Тур		
landling and Assembly Systems (L1591)		Lecture Recitation Section (small)	2	2
andling and Assembly Systems (L1738)		Lecture	2	2
utomation Technology (L1590) utomation Technology (L1739)		Recitation Section (small)	2	2
		Recitation Section (Smail)	I	I
Module Responsible	Prof. Thorsten Schüppstuhl			
	None			
Recommended Previous	without major course assessment			
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	Students			
	<ul> <li>know the characteristic components of a</li> </ul>	n automation avatame and have good understanding of the	rintoraction	
		n automation systems and have good understanding of their	rinteraction	
		s of automation tasks and are able to use them		
	<ul> <li>have special competences in industrial re-</li> </ul>	obot based automation systems		
Skills	Students are able to			
	<ul> <li>analyze complex Automation tooks</li> </ul>			
	analyze complex Automation tasks			
	develop application based concepts and			
	<ul> <li>design subsystems and integrate into on</li> </ul>			
	<ul> <li>investigate and evaluate safety of maching</li> </ul>			
	<ul> <li>create simple programs for robots and pr</li> </ul>			
	<ul> <li>design of circuit for pneumatic application</li> </ul>	ns		
Personal Competence				
Social Competence	Students are able to			
	- find solutions for automation and handling task	ks in groups		
	- develop solutions in a production environmen	t with qualified personnel at technical level and represent d	ecisions.	
Autonomy	Students are able to			
	<ul> <li>analyze automation tasks independently</li> </ul>	,		
	<ul> <li>generate programs for robots and program</li> </ul>			
	<ul> <li>develop solutions for practice oriented ta</li> </ul>			
	<ul> <li>develop solutions for practice offended ta</li> <li>design safety concepts for automation ap</li> </ul>			
	<ul> <li>assess consequences of their profession</li> </ul>			
	• assess consequences of their profession			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Product Development, Materials and Production	: Specialisation Product Development: Elective Compulsor	y	
Curricula	Product Development, Materials and Production	: Specialisation Production: Compulsory		
	Product Development Materials and Production	: Specialisation Materials: Elective Compulsory		
	riodadi Derelepinent, indendie die riodadien			
	Theoretical Mechanical Engineering: Technical			

Course L1	e L1591: Handling and Assembly Systems			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload	Independent Study Time 32, Study Time in Lecture 28			
in Hours				
Lecturer	Prof. Thorsten Schüppstuhl			
Language	DE			
Cycle	WiSe			
Content	Fundamentals and terminology of handling and assembly systems -Analysis of parts and handling tasks -Supply and transfer systems -Gripper -Industrial robots: structure, control and programming -Safety of machinery			
Literature	Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010			



	Тур	Recitation Section (small)	
	Hrs/wk	1	
	CP 1		
	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
	Lecturer	Prof. Thorsten Schüppstuhl	
	Language	DE	
	Cycle	WiSe	
	Content	See interlocking course	
	Literature	See interlocking course	
	590: Automation Technol	ogy	
Тур	Lecture		
Hrs/wk CP	2		
-		00 Chudu Tiere in Landuur 00	
Workload in Hours	Independent Study Time	32, Study Time in Lecture 28	
Lecturer	Prof. Thorsten Schüppstu	ihi	
Language	DE		
Cycle	SoSe		
	<ul> <li>Overview of different actuator concepts and their principles</li> <li>Design of pneumatic wiring diagrams</li> <li>Energyefficency in the production</li> <li>Review of automatic identification systems like Barcode and RFID</li> <li>Overview of the structure, components and algorithms of an image processing system</li> <li>Introduction to buscommunication an the different general concepts</li> <li>Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends</li> </ul>		
Literature			
	Horst Walter Grollius: Grundlagen der Pneumatik		
	Hubertus Murrenhoff: Grundlagen der Fluidtechnik		
	Christian Demant: Industrielle Bildverarbeitung		
	Michael ten Hompel: Identifikationssysteme und Automatisierung		
	Michael ten Hompel:	Identifikationssysteme und Automatisierung	

Course L1739: Automation Technology		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		



Module M1183: Laser systems and methods of manufacturing design and analysis				
Courses				
Title		Тур	Hrs/wk	CP
Laser Systems and Process Technologies	s (L1612)	Lecture	2	3
Methods for Analysing Production Process	ses (L0876)	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	Product Development, Materials and Production: Specia	alisation Product Development: Elective Con	npulsory	
Curricula	Product Development, Materials and Production: Specia	alisation Production: Compulsory		
	Product Development, Materials and Production: Specia	alisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Pro	duct Development and Production: Elective	Compulsory	
	Theoretical Mechanical Engineering: Technical Comple	mentary Course: Elective Compulsory		

Course L1612: Laser Systems and Process Technologies			
Тур	ecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Claus Emmelmann		
Language	EN		
Cycle	WiSe		
Content	<ul> <li>Fundamentals of laser technology</li> <li>Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers</li> <li>Laser system technology: beam forming, beam guidance systems, beam motion and beam control</li> <li>Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment</li> <li>Quality assurance and economical aspects of laser material processing</li> <li>Markets and Applications of laser technology</li> <li>Student group exercises</li> </ul>		
Literature	<ul> <li>Hügel, H., T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014.</li> <li>Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010.</li> <li>Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010.</li> <li>J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005.</li> <li>Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011</li> </ul>		



Course L0876: Methods for Analysing Production Processes	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Modelling and simulation of maching and forming processes</li> <li>Numerical simulation of forces, temperatures, deformation in machining</li> <li>Analysis of vibration problems in maching (chatter, modal analysis,)</li> <li>Knowledge based process planning</li> <li>Design of experiments</li> <li>Machinability of nonmetallic materials</li> <li>Analysis of interaction between maching process and machine tool systems with regard to process stability and quality</li> <li>Simulation of maching processes by virtual reality methods</li> </ul>
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)



Module M1342: Polymers				
Courses				
Title		Тур	Hrs/wk	CP
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Processing and design with polymers (L18		Lecture	2	3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous	Basics: chemistry / physics / material science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	bllowing learning results		
Professional Competence				
Knowledge	Students can use the knowledge of plastics and define	e the necessary testing and analysis.		
	They can explain the complex relationships structure-	property relationship and		
	the interactions of chemical structure of the polymers,	including to explain neighboring contexts	s (e.g. sustainability, envi	ironmental protection).
Skills	Students are capable of			
	- using standardized calculation methods in a giver	n context to mechanical properties (mo	odulus, strength) to calcu	ulate and evaluate the
	different materials.			
	- For mechanical recycling problems selecting appropr	iate solutions and sizing example Stiffne	ess, corrosion resistance.	
Personal Competence				
Social Competence	Students can,			
	- arrive at work results in groups and document them.			
	- provide appropriate feedback and handle feedback or	n their own performance constructively.		
Autonomy	Students are able to,			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific terms a	nd to define further work steps on this ba	asis guided by teachers.	
	- assess possible consequences of their professional	activity.		
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	Materials Science: Specialisation Engineering Materials: B	Elective Compulsory		
Curricula	Biomedical Engineering: Specialisation Implants and End	oprostheses: Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs a	nd Regenerative Medicine: Elective Compu	ulsory	
	Biomedical Engineering: Specialisation Management and	Business Administration: Elective Compuls	sory	
	Biomedical Engineering: Specialisation Medical Technology	gy and Control Theory: Elective Compulsor	ry	
	Product Development, Materials and Production: Specialis	sation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialis	sation Materials: Elective Compulsory		
	Product Development, Materials and Production: Specialis		oulsory	
	Theoretical Mechanical Engineering: Specialisation Mater	ials Science: Elective Compulsory		



Course L0389: Structure and Properties of Polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Hans Wittich	
Language		
Cycle	WiSe	
Content	- Structure and properties of polymers	
	- Structure of macromolecules	
	Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution	
	- Morphology	
	amorph, crystalline, blends	
	- Properties	
	Elasticity, plasticity, viscoelacity	
	- Thermal properties	
	- Electrical properties	
	- Theoretical modelling	
	- Applications	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	

Course L1892: Processing and design with polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich	
Language	DE/EN	
Cycle	WiSe	
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining	
	Designing with Polymers: Materials Selection; Structural Design; Dimensioning	
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag	
	Crawford: Plastics engineering, Pergamon Press	
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag	
	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Nodule M1185: Technical (	Complementary Course for PEPMS (according to Subject Specific Regulations)
Courses	
<b>Fitle</b>	Typ Hrs/wk CP
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	See selected module according to FSPO
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Examination	according to Subject Specific Regulations
Examination duration and scale	
Assignment for the Following	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory
Curricula	Product Development, Materials and Production: Specialisation Production: Elective Compulsory
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory

## **Specialization Production**

Graduates of the discipline production have in-depth knowledge of various production and manufacturing processes. They are qualified to evaluate those in the context of geometry creation, error control, cost effectiveness and humanization of work and are able to consider the interfaces of technology, organization and human, holistically.

odule M0763: Aircraft Sys	tems I			
ourses				
tle		Тур	Hrs/wk	CP
craft Systems I (L0735)		Lecture	3	4
craft Systems I (L0739)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Hydraulics			
	Control Systems			
Educational Objections	After the later of the state of			
-	After taking part successfully, students have reached	the following learning results		
Professional Competence	Chudanta ara abla ta			
Knowledge	Students are able to:			
	<ul> <li>Describe essential components and design p</li> </ul>	points of hydraulic, electrical and high-lift systems		
	Give an overview of the functionality of air cor	nditioning systems		
	<ul> <li>Explain the need for high-lift systems such as</li> </ul>	s ist functionality and effects		
	Assess the challenge during the design of su	pply systems of an aircraft		
Skills	Students are able to:			
	Design hydraulic and electric supply systems	of aircrafts		
	Design high-lift systems of aircrafts			
	Analyze the thermodynamic behaviour of air of the second sec	conditioning systems		
Personal Competence				
Social Competence	Students are able to:			
	<ul> <li>Perform system design in groups and present</li> </ul>	t and discuss results		
Autonomy	Students are able to:			
	<ul> <li>Reflect the contents of lectures autonomously</li> </ul>	/		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Ele	ective Compulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Cor			
	International Management and Engineering: Special			
		ecialisation Product Development: Elective Compulso	ry	
	Product Development, Materials and Production: Spe	ecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Spe			
	Product Development, Materials and Production: Spe Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Com	Aircraft Systems Engineering: Elective Compulsory		



Course L0735: Aircraft Systems I	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>

Course L0739: Aircraft Systems I	ourse L0739: Aircraft Systems I	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0867: Production	Planning & Control and Digital Enter	prise		
Courses		P		
Title		Тур	Hrs/wk	CP
The Digital Enterprise (L0932)		Lecture	2	2
Production Planning and Control (L0929)		Lecture	2	2
Production Planning and Control (L0930)		Recitation Section (small)	1	1
Exercise: The Digital Enterprise (L0933)		Recitation Section (small)	1	1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous	Fundamentals of Production and Quality Managen	nent		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module in	detail and take a critical position to them.		
Skills	Students are capable of choosing and applying mo	Students can explain the contents of the module in detail and take a chical position of them.		
Personal Competence				
Social Competence	Students can develop joint solutions in mixed team	ns and present them to others.		
Autonomy	.,			
Workload in Hours		984		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following	International Management and Engineering: Speci	ialisation II. Product Development and Production: Elect	ive Compulsory	
Curricula	Logistics, Infrastructure and Mobility: Specialisation	n Production and Logistics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial O	rgans and Regenerative Medicine: Elective Compulsory	/	
	Biomedical Engineering: Specialisation Implants a	and Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Te	echnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Managem	ent and Business Administration: Compulsory		
	Product Development, Materials and Production: S	Specialisation Product Development: Elective Compulso	ry	
	Product Development, Materials and Production: S	Specialisation Production: Compulsory		
	Product Development, Materials and Production: S	Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisatio	on Product Development and Production: Elective Comp	ulsory	
	Theoretical Mechanical Engineering: Technical Co	omplementary Course: Elective Compulsory		

Course L0932: The Digital Enterpris	e
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, AW.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006



Course L0929: Production Planning	Course L0929: Production Planning and Control		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Hermann Lödding		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Models of Production and Inventory Management</li> <li>Production Programme Planning and Lot Sizing</li> <li>Order and Capacity Scheduling</li> <li>Selected Strategies of PPC</li> <li>Manufacturing Control</li> <li>Production Controlling</li> <li>Supply Chain Management</li> </ul>		
Literature	<ul> <li>Vorlesungsskript</li> <li>Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008</li> <li>Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002</li> </ul>		

ourse L0930: Production Planning and Control	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0933: Exercise: The Digita	Course L0933: Exercise: The Digital Enterprise	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Axel Friedewald	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	Siehe korrespondierende Vorlesung	
	See interlocking course	



Module M1174: Automation	n Technology and Systems			
Courses				
Title		Typ	Hrs/wk	CP
Handling and Assembly Systems (L1591)		Typ Lecture	2	2
landling and Assembly Systems (L1391)		Recitation Section (small)	1	2
utomation Technology (L1590)		Lecture	2	2
Automation Technology (L1739)		Recitation Section (small)	1	1
Module Responsible	Prof. Thorsten Schüppstuhl			
Admission Requirements	None			
Recommended Previous	without major course assessment			
Knowledge	without major course assessment			
•	After taking part augeografully, atudente baye rook	abod the following loarning regults		
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence	Objection			
Knowledge	Students			
	<ul> <li>know the characteristic components of an</li> </ul>	n automation systems and have good understanding of the	r interaction	
		s of automation tasks and are able to use them		
	<ul> <li>have special competences in industrial re-</li> </ul>			
Skills	Students are able to			
	<ul> <li>analyza complex Automation tooka</li> </ul>			
	analyze complex Automation tasks			
	develop application based concepts and			
	design subsystems and integrate into on			
	<ul> <li>investigate and evaluate safety of maching</li> </ul>	-		
	<ul> <li>create simple programs for robots and pr</li> </ul>			
	<ul> <li>design of circuit for pneumatic application</li> </ul>	ns		
Personal Competence				
Social Competence	Students are able to			
	- find solutions for automation and handling task	s in groups		
	- develop solutions in a production environment	t with qualified personnel at technical level and represent d	ecisions	
Autonomy	Students are able to			
	<ul> <li>apolyzo outomotion tester index or to attach</li> </ul>			
	analyze automation tasks independently			
	generate programs for robots and progra			
	<ul> <li>develop solutions for practice oriented ta</li> </ul>			
	<ul> <li>design safety concepts for automation ap</li> </ul>			
	<ul> <li>assess consequences of their profession</li> </ul>	nal actions and responsibilities		
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Product Development, Materials and Production	: Specialisation Product Development: Elective Compulsor	у	
Curricula	Product Development, Materials and Production		,	
Guille	Product Development, Materials and Production			
	Theoretical Mechanical Engineering: Technical			
			loon	
	meoretical Mechanical Engineering: Specialisa	tion Product Development and Production: Elective Compu	usofy	

Course L1	591: Handling and Assembly Systems
Тур	Lecture
Hrs/wk	2
CP	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	Fundamentals and terminology of handling and assembly systems -Analysis of parts and handling tasks -Supply and transfer systems -Gripper -Industrial robots: structure, control and programming -Safety of machinery
Literature	Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010



	Тур	Recitation Section (small)	
	Hrs/wk	1	
	CP	1	
	Workload in Hours Independent Study Time 16, Study Time in Lecture 14		
	Lecturer Prof. Thorsten Schüppstuhl		
	Language	DE	
	Cycle	WiSe	
	Content	See interlocking course	
	Literature	See interlocking course	
	590: Automation Technol	ogy	
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	independent Study Time	32, Study Time in Lecture 28	
Lecturer	Prof. Thorsten Schüppstu	hl	
Language	DE		
Cycle	SoSe		
	<ul> <li>-Introduction to the production Automation including their different fields of application, importent terms, automation history and upcoming trends</li> <li>-Overview of different actuator concepts and their principles</li> <li>-Design of pneumatic wiring diagrams</li> <li>-Energyefficency in the production</li> <li>-Review of automatic identification systems like Barcode and RFID</li> <li>-Overview of the structure, components and algorithms of an image processing system</li> <li>-Introduction to buscommunication an the different general concepts</li> <li>-Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends</li> </ul>		
Literature	e Reinhard Langmann: Taschenbuch der Automatisierung		
	Holger Watter: Hydraulik und Pneumatik		
	Horst Walter Grollius: Grundlagen der Pneumatik Hubertus Murrenhoff: Grundlagen der Fluidtechnik		
	Christian Demant: Industrielle Bildverarbeitung		
	Michael ten Hompel: Identifikationssysteme und Automatisierung		
	Michael ten Hompel:	Identifikationssysteme und Automatisierung	

Course L1739: Automation Technology	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	



Module M1183: Laser syste	ems and methods of manufacturing desi	gn and analysis		
Courses				
Title		Тур	Hrs/wk	CP
Laser Systems and Process Technologies	s (L1612)	Lecture	2	3
Methods for Analysing Production Process	ses (L0876)	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	3		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	Product Development, Materials and Production: Spec	ialisation Product Development: Elective Con	npulsory	
Curricula	Product Development, Materials and Production: Spec	ialisation Production: Compulsory		
	Product Development, Materials and Production: Spec	ialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Pr	oduct Development and Production: Elective	Compulsory	
	Theoretical Mechanical Engineering: Technical Compl	ementary Course: Elective Compulsory		

Course L1612: Laser Systems and	Process Technologies		
Тур	acture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Claus Emmelmann		
Language	EN		
Cycle	WiSe		
Content	<ul> <li>Fundamentals of laser technology</li> <li>Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers</li> <li>Laser system technology: beam forming, beam guidance systems, beam motion and beam control</li> <li>Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment</li> <li>Quality assurance and economical aspects of laser material processing</li> <li>Markets and Applications of laser technology</li> <li>Student group exercises</li> </ul>		
Literature	<ul> <li>Hügel, H., T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014.</li> <li>Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010.</li> <li>Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010.</li> <li>J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005.</li> <li>Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011</li> </ul>		



Course L0876: Methods for Analysing Production Processes		
Тур		
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Modelling and simulation of maching and forming processes</li> <li>Numerical simulation of forces, temperatures, deformation in machining</li> <li>Analysis of vibration problems in maching (chatter, modal analysis,)</li> <li>Knowledge based process planning</li> <li>Design of experiments</li> <li>Machinability of nonmetallic materials</li> <li>Analysis of interaction between maching process and machine tool systems with regard to process stability and quality</li> <li>Simulation of maching processes by virtual reality methods</li> </ul>	
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)	



Courses				
Title .		Тур	Hrs/wk	CP
Computer and communication technology		Lecture	2	2
Computer and communication technology		Recitation Section (small)	1	1 3
Model-Based Systems Engineering (MBSI	Prof. Ralf God	Problem-based Learning	3	3
Module Responsible				
Admission Requirements Recommended Previous	None Recip knowledge in:			
Knowledge	Basic knowledge in: • Mathematics			
Khowledge	Mathematics     Mechanics			
	Thermodynamics			
	,			
	Electrical Engineering			
	Control Systems			
	Previous knowledge in:			
	Systems Engineering			
Educational Objectives	After taking part successfully, students have reached the follow	ing loorning results		
Professional Competence	Aller taking part successionly, students have reached the follow	ing learning lesuits		
Knowledge	Students are able to:			
Knowledge				
	describe the structure and operation of computer architecture     available the structure and operation of digital communication is			
	<ul> <li>explain the structure and operation of digital communication I</li> <li>explain architectures of cabin electronics, integrated modular</li> </ul>		ation Notwork (ADCN	I)
		. ,		
	understand the approach of Model-Based Systems Engineeri	ing (MDSE) in the design of hardware and so	Jiware-Dased Cabins	systems
Skills	Students are able to:			
	<ul> <li>understand, operate and maintain a Minicomputer</li> </ul>			
	• build up a network communication and communicate with oth	er network participants		
	• connect a minicomputer with a cabin management system (A	380 CIDS) and communicate over a AFDX®	-Network	
	• model system functions by means of formal languages SysMI	/UML and generate software code from the	models	
	execute software code on a minicomputer			
Personal Competence				
Social Competence	Students are able to:			
Social Competence	elaborate partial results and merge with others to form a com			
	· elaborate partial results and merge with others to form a comp			
Autonomy	Students are able to:			
	<ul> <li>organize and schedule their practical tasks</li> </ul>			
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	Aircraft Systems Engineering: Specialisation Aircraft Systems:	Elective Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation	Systems: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Cabin Systems: C	, , ,		
	International Management and Engineering: Specialisation II.			
	Product Development, Materials and Production: Specialisatio		ry	
	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio			
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy			
	Theoretical Mechanical Engineering: Openalisation metal of			



Course L1557: Computer and comm	nunication technology in cabin electronics and avionics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic
	systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays
	requires a basic understanding of cabin electronics and avionics.
	The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and
	applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:
	History of computer and network technology
	Layer model in computer technology
	Computer architectures (PC, IPC, Embedded Systems)
	BIOS, UEFI and operating system (OS)
	Programming languages (machine code and high-level languages)
	Applications and Application Programming Interfaces
	External interfaces (serial, USB, Ethernet)
	Layer model in network technology
	Network topologies
	Network components
	Bus access procedures
	Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)
	Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung
	- Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books
	on Demand; 1. Auflage, 2003
	- Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1
	Auflage, 2004
	- Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren
	Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1558: Computer and comm	nunication technology in cabin electronics and avionics
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and
	applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:      History of computer and network technology      Layer model in computer technology      Computer architectures (PC, IPC, Embedded Systems)      BIOS, UEFI and operating system (OS)      Programming languages (machine code and high-level languages)      Applications and Application Programming Interfaces      External interfaces (serial, USB, Ethernet)      Layer model in network technology      Network topologies      Network components      Bus access procedures      Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)      Cabin electronics and cabin networks
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003</li> <li>Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004</li> <li>Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006</li> </ul>



Course L1551: Model-Based System	Course L1551: Model-Based Systems Engineering (MBSE) with SysML/UML		
Тур	Problem-based Learning		
Hrs/wk	3		
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	SoSe		
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project		
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011		



Module M0511: Electricity C	Generation from Wind and Hydro Power			
Courses				
Title		Тур	Hrs/wk	CP
Renewable Energy Projects in Emerged N	larkets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore (L001	2)	Lecture	1	1
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous	Module: Technical Thermodynamics I,			
Knowledge	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results		
Professional Competence				
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions ar can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of wat power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countrie outside Europe.			nentally the use of wate
	Through active discussions of various topics within the seminar of the module, students improve their understanding and the application theoretical background and are thus able to transfer what they have learned in practice.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
Social Competence	Students can discuss scientific tasks subjet-specificly and n	nultidisciplinary within a seminar.		
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following				
Curricula	Civil Engineering: Specialisation Structural Engineering. En			
Guilleula	Civil Engineering: Specialisation Coastal Engineering: Elec			
	Energy and Environmental Engineering: Specialisation Ene			
			J	
	International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisa		illoor y	
	Product Development, Materials and Production: Specialisa Product Development, Materials and Production: Specialisa			
	Renewable Energies: Core qualification: Compulsory	aton materials. Liective Compulsory		
		Engineering Elective Computer		
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Environment: Compulsory			
	Water and Environmental Engineering: Specialisation Cities	s. Elective Compulsory		



Course L0014, Benewable Energy F	Invianta in Emorged Marketa	
Course L0014: Renewable Energy P		
Тур	Project Seminar	
Hrs/wk		
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer		
Language	DE	
Cycle	SoSe	
Content	1. Introduction	
	<ul> <li>Development of renewable energies worldwide</li> </ul>	
	<ul> <li>Bevelophient of renewable energies worldwide</li> <li>History</li> </ul>	
	<ul> <li>Future markets</li> </ul>	
	<ul> <li>Special challenges in new markets - Overview</li> </ul>	
	2. Sample project wind farm Korea	
	Survey	
	Technical Description	
	<ul> <li>Project phases and characteristics</li> </ul>	
	3. Funding and financing instruments for EE projects in new markets	
	Overview funding opportunitie	
	Overview countries with feed-in laws	
	<ul> <li>Major funding programs</li> </ul>	
	4. CDM projects - why, how , examples	
	Overview CDM process	
	• Examples	
	• Exercise CDM	
	5. Rural electrification and hybrid systems - an important future market for EE	
	Rural Electrification - Introduction	
	<ul> <li>Types of Elektrizifierungsprojekten</li> </ul>	
	<ul> <li>The role of the EEInterpretation of hybrid systems</li> </ul>	
	Project example: hybrid system Galapagos Islands	
	6. Tendering process for EE projects - examples	
	South Africa	
	• Brazil	
	7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank	
	<ul> <li>Geothermal</li> </ul>	
	Wind or CSP	
	Within the seminar, the various topics are actively discussed and applied to various cases of application.	
Literature	Folien der Vorlesung	

Course L0013: Hydro Power Use	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Stephan Heimerl
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction, importance of water power in the national and global context</li> <li>Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies</li> <li>Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems</li> <li>Construction of hydroelectric power plants: description of the individual components and their technical system interaction</li> <li>Structural engineering components: representation of dams, weirs, dams, power houses, computer systems, etc.</li> <li>Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection</li> <li>Hydropower and the Environment</li> <li>Examples from practice</li> </ul>
Literature	<ul> <li>Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage</li> <li>Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage</li> <li>Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage</li> <li>von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage</li> <li>Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006</li> </ul>



Course L0011: Wind Turbine Plants	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann
Language	DE
Cycle	SoSe
Content	<ul> <li>Historical development</li> <li>Wind: origins, geographic and temporal distribution, locations</li> <li>Power coefficient, rotor thrust</li> <li>Aerodynamics of the rotor</li> <li>Operating performance</li> <li>Power limitation, partial load, pitch and stall control</li> <li>Plant selection, yield prediction, economy</li> <li>Excursion</li> </ul>
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy Use - F	ocus Offshore
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering</li> <li>Physical fundamentals for utilization of wind energy</li> <li>Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships</li> <li>Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures</li> <li>Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection</li> <li>Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics</li> <li>Development and planning of offshore wind farms</li> <li>Operation and optimization of offshore wind farms</li> <li>Day excursion</li> </ul>
Literature	<ul> <li>Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage</li> <li>Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage</li> <li>Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage</li> <li>Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage</li> </ul>



Courses				
Title .		Тур	Hrs/wk	CP
Supply Chain Management (L1218)		Problem-based Learning	3	4
/alue-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	None			
Recommended Previous	no			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Current developments in international business activities suc	h as outsourcing, offshoring, internationaliza	ation and globalizatio	n and emerging mar
	illustrated by examples from practice.			
	Theoretical Approaches and methods in logistics and supply	chain management and use in practice.		
	• to identify fields of decision in SCM .			
	• reasons for the formation of networks based on various theo	ries from institutional economics (transactio	n cost theory, principa	al-agent theory, prop
	right theory) and the resource-based view.			
	· Selected approaches to explain the development of networks			
	<ul> <li>to illustrate phases of network formation.</li> </ul>			
	• to understand the functional mechanisms of inter-organizatio	nal and international network relationships.		
	• to explain and categorize relationships within networks.			
	• to categorize sourcing concepts and explain motives/ barriers	or advantages and disadvantages.		
	<ul> <li>advantages and disadvantages of offshoring and outsourcing</li> </ul>	and to illustrate the distinction between the	two terms .	
	• to state criteria/ factors/ parameters that influence production			
	<ul> <li>to explain methods for location finding/evaluation.</li> </ul>	Č (	,	
	• to interpret phenotypes of production networks.			
	<ul> <li>recognize relationships between R &amp; D and production and the</li> </ul>	neir locations and to describe coherent mode	els.	
	• to solve sub-problems with the configuration of logistics netw			iate approaches.
	<ul> <li>to categorise special waste logistics including their duties &amp; c</li> </ul>			
			oxampice er good ne	, in on ang.
Skills	• to asses trends and challenges in national and international	supply chains and logistics networks and the	ir consequences for a	companies.
	• to evaluate, anallse and systematise networks and network r	elations based on the lecture.		
	• to anaylse partners and their suitability for co-operation in collaborations and cooperative relations.			
	· to select sourcing concepts for specific products / product	components based on the lecture as well	l as advantages and	I disadvantages of e
	approach.			
	• to evaluate location decisions for production and R & D base	d on concepts.		
	$\mbox{ \ \ }$ to recognize relationships between R & D and production	as well as their locations and to evaluate	the suitability of spe	cific models for diffe
	situations.			
	• to transfer the analyzed concepts to international practices.			
	• to analyse and evaluate the product development processes			
	• to anaylse concepts of Information and communication mana	gement in logistics.		
	• to design subcontracting, procurement, production and dispo	sal as well as R & D networks to shape,		
	• to plan reorganise efficient and flow-oriented enterprise netw	orks.		
	<ul> <li>to adopt methods of complexity management and risk management in logistics.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>to evaluate intercultural and international relationships based</li> </ul>			
	<ul> <li>advance planning and design of network formation and their</li> </ul>	tion and their objectives based on content discussed in the lecture.		
	definition of procurement strategies for individual parts using	the gained knowledge of procurement netwo	orks.	
	design of the procurement network (external/internal/module	s etc.) based on the sourcing concepts and	core competencies, a	as well as on the find
	of the case studies.			
	• to make decision of location for production taking into acc	ount global contexts, evaluation methods	and buying/selling m	arkets, which were
	discussed in the case studies and their dependence on R & D			
	Decision on R & D locations based on the insights gained fro	m case studies / practical examples and the	selection of an appro	priate model.
A		independently on the system of Cymely C	hain Managanant a	
Autonomy				
	knowledge to new problems.			
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	International Management and Engineering: Specialisation I. E			
Curricula	Logistics, Infrastructure and Mobility: Specialisation Production			
	Product Development, Materials and Production: Specialisation	n Product Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation	n Production: Elective Compulsory		
		n Materials: Elective Compulsory		



Course L1218: Supply Chain Manag	
Тур	Problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language Cycle	DE SoSe
Content	<ul> <li>Transmission of a profound understanding in logistics and supply chain management</li> <li>Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts t business cases</li> <li>Identification of trends and challenges in national and international supply chains</li> <li>Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push of the strategic supply chain approaches)</li> </ul>
	<ul> <li>pull-based strategies, efficiency vs. responsiveness)</li> <li>Elaboration of approaches and goals in the field of resource planning and supplier management</li> <li>Identification and analyzes of concepts in logistics management</li> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul>
	Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 <sup>rd</sup> edition, Upper Saddle River, NJ, Pearson/Prentic Hall. Heizer, J. und Render, B. (2006): Principles of Operations Management. Prentice Hall. Fisher, M. (1997): What is the right supply chain for your product?, Harvard Business Review, Vol. 75, No. pp., S. 105-116. Kuhn, A. und Hellingrath, B. (2002): Supply Chain Management: optimierte Zusammenarbeit in der Wertschöpfungskette, Berlin [u.a.], Springer. Larson, P., Poist, R., Halldórsson, Á. (2007): PERSPECTIVES ON LOGISTICS VS. SCM: A SURVEY OF SCM PROFESSIONALS, in: Journal of Business Logistics, Vol. 28, No. 1, 2007, S. 3ff. Kummer, S., Hrsg. (2006): Grundzüge der Beschaffung, Produktion und Logistik, München: Pearson Studium. Porter, M. (1986): Changing Patterns of International Competition, California Management Review, Vol. 28, No. 2, pp. 9-40. Simchi-Levi, D., Kaminsky, P. und Simchi-Levi, E. (2008): Designing and managing the supply chain: concepts, strategies and case studies, 3. ed McGraw-Hill. Supply Chain Council (2010): Supply Chain Operations Reference (SCOR) model: Overview – Version 10.0, [online] :: http://supplychain.org/f/Web Sco Overview.pdf.
	Swink, M., Melnyk, S. A., Cooper, M. B., Hartley, J. L. (2011): Managing Operations – Across the Supply Chain. McGraw-Hill/Irwin.



Course L1190: Value-Adding Netwo	rks
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Blecker
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>



Module M0630: Robotics a	nd Navigation in Medicine			
Courses				
Title		Тур	Hrs/wk	CP
Robotics and Navigation in Medicine (L033		Lecture	2	3
Robotics and Navigation in Medicine (L03		Project Seminar	2	2
Robotics and Navigation in Medicine (L03		Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous	<ul> <li>principles of math (algebra, analysis/calculu)</li> </ul>	s)		
Knowledge	<ul> <li>principles of programming, e.g., in Java or C</li> </ul>			
	<ul> <li>solid R or Matlab skills</li> </ul>			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence		J J		
Knowledge	The students can explain kinematics and tracking	systems in clinical contexts and illustrate systems an	d their components in	details. Systems can be
, and modge		ifety and regulations. Students can assess typical systematic		
			enne regularing deeligh	
Skills	The students are able to design and evaluate navig	ation systems and robotic systems for medical applica	tions.	
Personal Competence				
Social Competence	The students discuss the results of other groups, pr	ovide helpful feedback and can incoorporate feedback	into their work.	
A . I	The state of the s		the factor of the second states	
Autonomy	The students can reflect their knowledge and docul	nent the results of their work. They can present the res	uits in an appropriate i	nanner.
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	Computer Science: Specialisation Intelligence Eng	neering: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Medical Tech	nology: Elective Compulsory		
	Computational Science and Engineering: Specialis	ation Systems Engineering and Robotics: Elective Co	mpulsory	
	International Management and Engineering: Specia	alisation II. Electrical Engineering: Elective Compulsor	у	
	Mechatronics: Specialisation Intelligent Systems ar	d Robotics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Or	gans and Regenerative Medicine: Elective Compulsor	ŷ	
	Biomedical Engineering: Specialisation Implants and	nd Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Te	chnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manageme	ent and Business Administration: Elective Compulsory		
	Product Development, Materials and Production: S	pecialisation Product Development: Elective Compulse	ory	
	Product Development, Materials and Production: S	pecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	pecialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Co	mplementary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Bio- and Medical Technology: Elective Compulsory		

Course L0335: Robotics and Navigation in Medicine		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	EN	
Cycle	SoSe	
Content	- kinematics	
	- calibration	
	- tracking systems	
	navigation and image guidance	
	motion compensation	
	The seminar extends and complements the contents of the lecture with respect to recent research results.	
Literature	Spong et al.: Robot Modeling and Control, 2005	
	Troccaz: Medical Robotics, 2012	
	Further literature will be given in the lecture.	

Cycle SoSe

Content Literature

See interlocking course

See interlocking course



Course L0338: Robotics and Naviga	ourse L0338: Robotics and Navigation in Medicine			
Тур	Project Seminar			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Alexander Schlaefer			
Language	EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			
Course L0336: Robotics and Naviga	ation in Medicine			
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	EN			



Modulo M0764: Aircraft Syr	stome II			
Module M0764: Aircraft Sys				
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Systems II (L0736)		Lecture	3	4
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge				
	mathematics			
	mechanics			
	thermo dynamics			
	electronics			
	fluid technology			
	control technology			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to			
	<ul> <li>describe the structure of primary flight control systems</li> </ul>	as well as actuation, avionic, fuel, an	d landing gear-syste	me in general along wi
	corresponding properties and applications.	as well as actuation-, aviolite-, tuel- and	u lanunig gear-syste	ins in general along wi
	<ul> <li>explain different configurations and designs and their or</li> </ul>	iging		
	<ul> <li>explain atmospheric conditions for icing such as the func-</li> </ul>	autility of anti-ice systems		
Skills	Students are able to			
	<ul> <li>size primary flight control actuation systems</li> </ul>			
	<ul> <li>perform a controller design process for the flight control a</li> </ul>	actuators		
	<ul> <li>design high-lift kinematics</li> </ul>			
	<ul> <li>design and analyse landing gear systems</li> </ul>			
	design anti-ice systems			
Personal Competence				
	Students are able to:			
Social Competence				
	Develop joint solutions in mixed teams			
Autonomy	Students are able to:			
	<ul> <li>derive requirements and perform appropriate yet simpli</li> </ul>	fied design processes for aircraft systems	s from complex issue	s and circumstances in
	self-reliant manner			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II. A	viation Systems: Elective Compulsorv		
	Product Development, Materials and Production: Specialisation		ry	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Technical Complementary			
	Theoretical Mechanical Engineering: Specialisation Aircraft Sys			
	meoreacal mechanical Engineering. Specialisation AlfCrait Sys	terna Engineering. Elective Compulsory		



Course L0736: Aircraft Systems II	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	<ul> <li>Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems)</li> <li>Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems)</li> <li>Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems)</li> <li>Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>Curry: Aircraft Landing Gear Design: Principles and Practices</li> </ul>

Course L0740: Aircraft Systems II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Iodule M0811: Medical Ima	iging Systems			
courses				
itle		Тур	Hrs/wk	CP
ledical Imaging Systems (L0819)		Lecture	4	6
Module Responsible	Dr. Michael Grass			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge				
	Students can:			
	Describe the system configuration and components of	the main clinical imaging systems:		
	<ul> <li>Explain how the system components and the overall st</li> </ul>		n.	
	<ul> <li>Explain now the system components and the overall s</li> <li>Explain and apply the physical processes that make in</li> </ul>			
	<ul> <li>Name and describe the physical effects required to ge</li> </ul>		damental physical equations,	
	<ul> <li>Explain how spatial and temporal resolution can be in:</li> </ul>		images generated;	
	<ul> <li>Explain which image reconstruction methods are used</li> </ul>			
	Describe and explain the main clinical uses of the different sy			
01.11				
Skills	Students are able to:			
	<ul> <li>Explain the physical processes of images and assign t</li> </ul>	o the systems the basic mathematica	I or physical equations required	;
	<ul> <li>Calculate the parameters of imaging systems up</li> </ul>	sing the mathematical or physical eq	juations;	
	<ul> <li>Determine the influence of different system con</li> </ul>	ponents on the spatial and temporal	I resolution of imaging systems;	
	<ul> <li>Explain the importance of different imaging sys</li> </ul>	tems for a number of clinical applicat	tions;	
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence				
Autonomy	Students can:			
	<ul> <li>Understand which physical effects are used in medica</li> </ul>	imaging;		
	Decide independently for which clinical issue a measurement	ring system can be used.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
	Electrical Engineering: Specialisation Medical Technology: El	ective Compulsory		
Curricula	Biomedical Engineering: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation		ompulsory	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Technical Complementa		loon	
	Theoretical Mechanical Engineering: Specialisation Bio- and	viedical rechnology: Elective Compl	usory	
ourse L0819: Medical Imaging Sys	tems			
	Lecture			
Hrs/wk	4			

Тур	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book:
	1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press
	Secondary books:
	- A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003.
	- W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002.
	- H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995.
	- O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.



## Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Production System	s (L0927)	Problem-based Learning	2	3
Emotional Design / User Centered Produc	t Development (L1703)	Seminar	2	2
Development Management for Mechatroni	cs (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Struc	tures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc	tures (L0501)	Laboratory Course	1	1
ightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
ightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
ightweight Design Practical Course (L125	i8)	Problem-based Learning	3	3
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Applications		Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)		Lecture	2	4
Productivity Management (L0928)		Problem-based Learning	2	2
Productivity Management (L0920)		Recitation Section (small)	1	1
Feedback Control in Medical Technology (	10664)	Lecture	2	3
	20004)	Lecture	2	2
Renewable Energy (L0313)				
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transportation (L08	355)	Lecture	3	3
Fechnical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynamics (L0176		Lecture	2	2
Reliability in Engineering Dynamics (L1303	.)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge				
	<ul> <li>Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection of different special fields or application areas of produces the connection or application areas of produces the connection or application areas of produces the connection or application areas of produces</li></ul>			
	development, materials and production			
	<ul> <li>Students are qualified to connect different special field</li> </ul>	ds with each other		
	Students are qualified to connect different special field	ds with each other		
Skills				
Skills	Students can apply specialized solution strategies an	d new scientific methods in selected areas		
Skills		d new scientific methods in selected areas	ution approaches	
	Students can apply specialized solution strategies an	d new scientific methods in selected areas	ution approaches	
Personal Competence	Students can apply specialized solution strategies an	d new scientific methods in selected areas	ution approaches	
	Students can apply specialized solution strategies an	d new scientific methods in selected areas	ution approaches	
Personal Competence	<ul> <li>Students can apply specialized solution strategies an</li> <li>Students are able to transfer learned skills to new and</li> </ul>	d new scientific methods in selected areas d unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence	Students can apply specialized solution strategies an	d new scientific methods in selected areas d unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence	<ul> <li>Students can apply specialized solution strategies an</li> <li>Students are able to transfer learned skills to new and</li> </ul>	d new scientific methods in selected areas d unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence Autonomy	<ul> <li>Students can apply specialized solution strategies an</li> <li>Students are able to transfer learned skills to new and</li> <li>Students are able to develop their knowledge and ski</li> </ul>	d new scientific methods in selected areas d unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence Autonomy Workload in Hours Credit points	<ul> <li>Students can apply specialized solution strategies an</li> <li>Students are able to transfer learned skills to new and</li> <li>Students are able to develop their knowledge and ski</li> <li>Depends on choice of courses</li> <li>12</li> </ul>	d new scientific methods in selected areas d unknown problems and can develop own sol lls by autonomous election of courses.		
Personal Competence Social Competence Autonomy Workload in Hours	<ul> <li>Students can apply specialized solution strategies an</li> <li>Students are able to transfer learned skills to new and</li> <li>Students are able to develop their knowledge and ski</li> <li>Depends on choice of courses</li> </ul>	d new scientific methods in selected areas d unknown problems and can develop own sol lls by autonomous election of courses.		



Course L159	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in	Independent Study Time 48, Study Time in Lecture 42
Hours	
Examination	Mündliche Prüfung
Form	
Examination	30 Minuten
duration	
and scale	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrated Production Systems		
Тур	Problem-based Learning	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	not available	
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.	
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.	
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.	
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.	
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.	
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.	
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.	

Course L1703: Emotional Design / User Centered Product Development	
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	<ul> <li>Lecture</li> <li>Objective and subjective perception for the evaluation of product characteristics</li> <li>Effects of material, color, shape and structure to the acceptance of a product</li> <li>Aesthetic function of a product</li> <li>Case studies, lack of acceptance of a product and possible reason</li> </ul> Seminar <ul> <li>Identification of non-technical product functions</li> <li>Identification of subjective influences for the product development</li> </ul> Project Work <ul> <li>Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated</li> </ul> Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben



Course L1512: Development Management for Mechatronics		
Тур		
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 Minuten	
Lecturer	Dr. Daniel Steffen	
Language	DE	
Cycle		
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>	
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>	

Course L0310: Fatigue & Damage T	course L0310: Fatigue & Damage Tolerance		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Mündliche Prüfung		
Examination duration and scale	45 min		
Lecturer	Dr. Martin Flamm		
Language	EN		
Cycle	WiSe		
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,		
	environmental influences		
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur		
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989		



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	
Content	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight struct used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applicat is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwo structures as well as their application fields.
Literature	Locture Nation and selected papage
	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> </ul>
	<ul> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> </ul>
	D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook
	D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics		
Тур		
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Dr. Marco Schürg	
Language	DE	
Cycle	WiSe	
Content	Fundamentals of Anisotropic Elasticity	
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law	
	Behaviour of a single laminate layer	
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules	
	Fundamentals of Micromechanics of a laminate layer	
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer	
	Classical Laminate Plate Theory	
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties	
	Strength of Laminated Plates	
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin	
	Bending of Composite Laminated Plates	
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions	
	Stress Concentration Problems	
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis	
	Stability of Thin-Walled Composite Structures	
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and thei evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles	
	Written exercise (report required)	
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account	
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>	

Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1258: Lightweight Design Practical Course		
Тур	Problem-based Learning	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Prof. Dieter Krause	
Language	DE/EN	
Cycle	SoSe	
Content	Development of a sandwich structure made of fibre reinforced plastics	
	<ul> <li>getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>Determination of material properties based on sample tests</li> <li>manufacturing of the structure in the composite lab</li> <li>Testing of the developed structure</li> <li>Concept presentation</li> <li>Self-organised teamwork</li> </ul>	
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>	

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	Aircraft Applications
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements,
	thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	1. Introduction/process of aircraft design/various aircraft configurations
	2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)
	3. Statistical methods in overall aircraft design/data base methods
	4. Principles of aircraft performance design (stability, V-n-diagramme)
	5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)
	6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)
	7. Principles of engine design and integration
	8. Cruise design
	9. Design of runway and landing field length
	10. Cabin design (fuselage dimensioning, cabin interior, loading systems)
	11. System- and equipment aspects
	12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology		
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Prof. Hoc Khiem Trieu	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (water fabrication, photolithography, improving resolution, next-generation lithography, nancimprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVE LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching wit KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, NE, Bosch process, LOR 2 KP2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LICA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor; photometry, radiometry IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor; piezoresistive, eapacitiv and fabrication process; (acklanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnet resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzym electrode, Enzym electrokinetic micropamps, micromixer, filler, inkjet printheac microglapene</li></ul>	
Literature		
	N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009	
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010	
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008	



Course L0928: Productivity Management		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>	
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985	

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Ulf Pilz, Prof. Olaf Simanski	
Language	DE	
Cycle	SoSe	
Content	Taking an engineering point of view, the lecture is structured as follows.	
	<ul> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/ rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.	
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart	
	Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag	
	M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000	



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	Introduction and structuring     Basic terms of quality management     Measuring and inspection equipment     Tools of quality management: FMEA, QFD, FTA, etc.     Quality management methodology Six Sigma, DMAIC  Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L0855: System Analysis in Air Transportation	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>
Literature	Hand out

Course L1513: Technical Design	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Hausarbeit
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



ЗC	. "Product Development, Materials and Production"	Technisc
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	
	DRAWING	
	Barons Educational Series	
	ISBN-13: 978-0-7641-6182-7	
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept	
	Presentation for Designers and Illustrators	
	Watson-Guptil Publication a division of Billboard Publications Inc.,	
	New York 1985	
	AIRWORLD	
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
	Perter Deslius Jacek Slaski te Neues 2005	
	Technik und Sicherheit von Passagierflugzeugen	
	Frank Littek	
	Motorbuch Verlag 2003	
	Jetliner Cabins	
	Jennifer Coutts Clay	
	Cs books England 2006	
	BOEING Widebodies	
	Michael Haenggi motorbooks international USA 2003	
	form - Zeitschrift für Gestaltung, Verlag form GmbH,	
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim	
	(erscheint vierteljährlich, Verlag form GmbH)	
	design report	
	german magasin,	
	(erscheint monatlich)	
	md - möbel interior design, Konradin-Verlag	
	Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen	
	(erscheint monatlich)	
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,	
	Kitashinjuku, Shinjuku-ku, Tokio 160, Japan	
	(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland Gm	ıbH,
	Auto & Design,	
	Corso Frabcia 161, 10139 Torino, Italia	
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei	

Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
	Dr. Rolf Janßen
Language	
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (solid state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed. Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.
	Content: 1. Introduction
	Inhalt: 2. Raw materials
	3. Powder fabrication
	4. Powder processing
	5. Shape-forming processes
	6. Densification, sintering
	7. Glass and Cement technology
	8. Ceramic-metal joining techniques
Literature	W.D. Kingery, "Introduction to Ceramics", John Wiley & Sons, New York, 1975
	ASM Engineering Materials Handbook Vol.4 "Ceramics and Glasses", 1991
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung



Course L0949: Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems <ul> <li>Modeling</li> <li>System identification</li> <li>Simulation</li> <li>Processing of measurement data</li> <li>Damage accumulation</li> <li>Test planning and execution</li> </ul>
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 L1303: Reliability in Engineering Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 min
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0749: Reliability of Aircraft Systems	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



Module M1143: Mechanical	Design Methodology			
Module M1145. Mechanica	Design Methodology			
Courses				
Title		Тур	Hrs/wk	CP
Mechanical Design Methodology (L1523)		Lecture	3	4
Mechanical Design Methodology (L1524)		Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Science-based working on product design considering targeted at	oplication of specific product design tec	hniques	
Skills	Creative handling of processes used for scientific preparation a	nd formulation of complex product de	sian problems / Applic	nation of various product
	design techniques following theoretical aspects.		olgh problomo / Applie	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	International Management and Engineering: Specialisation II. Proc	duct Development and Production: Elec	tive Compulsory	
Curricula	Mechatronics: Specialisation System Design: Elective Compulsory	,		
	Biomedical Engineering: Specialisation Artificial Organs and Rege	enerative Medicine: Elective Compulsor	У	
	Biomedical Engineering: Specialisation Implants and Endoprosthe	eses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and	Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Busines	ss Administration: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Pr	oduct Development: Elective Compulse	ory	
	Product Development, Materials and Production: Specialisation Pr	oduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation M			
	Theoretical Mechanical Engineering: Specialisation Product Deve		oulsory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		

Course L1523: Mechanical Design	/lethodology
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Josef Schlattmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>



Course L1524: Mechanical Design	Aethodology
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Josef Schlattmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>



Module M1145: Automation	and Simulation			
•				
Courses				
Title		Тур	Hrs/wk	CP
Automation and Simulation (L1525) Automation and Simulation (L1527)		Lecture Recitation Section (large)	3 2	3
Module Responsible	NN	Hecitation Section (large)	2	3
Admission Requirements	None			
Recommended Previous	BSc Mechanical Engineering or similar			
Knowledge	boc mechanical Engineering of annual			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	· · · · · · · · · · · · · · · · · · ·			
Knowledge				
Skills	Students can describe and design simple controllers using established methodes. They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant. They can modell and simulate technical systems with respect to their dynamical behaviour and can use Matlab/Simulink for the simulation. They are able to applay established methods for the caclulation of the dynamical behaviour of three-phase machines.			
Personal Competence Social Competence Autonomy	Teamwork in small teams. Students are able to identify the need of methocic analysises in t evaluate the results critically.	he field of automation systems, to do th	nese analysisis in an	adequate manner und t
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde			
Assignment for the Following	Energy Systems: Core qualification: Elective Compulsory			
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elect	ive Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elec International Management and Engineering: Specialisation II. Ene International Management and Engineering: Specialisation II. Avia International Management and Engineering: Specialisation II. Proc Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Product Development, Materials and Production: Specialisation Pro-	rgy and Environmental Engineering: Election Systems: Elective Compulsory duct Development and Production: Election ective Compulsory	tive Compulsory	
	Product Development, Materials and Production: Specialisation Pro- Product Development, Materials and Production: Specialisation Pro- Product Development, Materials and Production: Specialisation M	oduction: Elective Compulsory	· ;	



Course L1525: Automation and Sim	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	NN
Language	DE
Cycle	SoSe
Content	Structure of automation systsems
	Aufbau von Automationseinrichtungen
	Structure and function of process computers and corresponding componentes
	Data transfer via bus systems
	Programmable Logic Computers
	Methods to describe logic sequences
	Prionciples of the modelling and the simulation of continous technical systems
	Practical work with an established simulation program (Matlab/Simulink)
	Simulation of the dynamic behaviour of a three-phase maschine, simulation of a mixed continous/discrete system on base of tansistion flow diagrams.
Literature	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag
	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren

Course L1527: Automation and Sim	Course L1527: Automation and Simulation	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	NN	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1156: Systems E	ngineering			
Courses				
Title		Тур	Hrs/wk	CP
Systems Engineering (L1547)		Lecture	3	4
Systems Engineering (L1548)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
	Previous knowledge in:			
	Aircraft Cabin Systems			
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to:			
	• understand systems engineering process models, method	Is and tools for the development of complex Sy	stems	
	describe innovation processes and the need for technolog	y Management		
	• explain the aircraft development process and the process	of type certification for aircraft		
	• explain the system development process, including requir	ements for systems reliability		
	• identify environmental conditions and test procedures for a	airborne Equipment		
	• value the methodology of requirements-based engineerin	g (RBE) and model-based requirements engin	eering (MBRE)	
Skille	Students are able to:			
okiiis	plan the process for the development of complex Systems			
	<ul> <li>organize the development phases and development Task</li> </ul>			
	assign required business activities and technical Tasks	5		
	apply systems engineering methods and tools			
	apply systems engineering methods and tools			
Personal Competence				
Social Competence	Students are able to:			
	• understand their responsibilities within a development tea	m and integrate themselves with their role in th	ne overall process	
Autonomy	Students are able to:			
	<ul> <li>interact and communicate in a development team which h</li> </ul>	as distributed tasks		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulso	ry		
Curricula	International Management and Engineering: Specialisation	•		
	International Management and Engineering: Specialisation		tive Compulsory	
	Mechatronics: Specialisation System Design: Elective Com			
	Mechatronics: Specialisation Intelligent Systems and Robo			
	Product Development, Materials and Production: Specialisa	1 2		
	Product Development, Materials and Production: Specialisa			
	Product Development, Materials and Production: Specialisa			
	Theoretical Mechanical Engineering: Technical Compleme			
	Theoretical Mechanical Engineering: Specialisation Aircraf			



Course L1547: Systems Engineerin	g
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems
	using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved
	Regulations, guidelines and certification issues will be known.
	Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools
	and methods for systems engineering:
	Innovation processes
	IP-protection
	Technology management
	Systems engineering
	Aircraft program
	Certification issues
	Systems development
	Safety objectives and fault tolerance
	Environmental and operating conditions
	Tools for systems engineering
	Requirements-based engineering (RBE)
	Model-based requirements engineering (MBRE)
Literature	- Skript zur Vorlesung
	- diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE)
	- Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010
	- NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007
	- Hinsch, M.: Industrielles Luftfahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010
	- De Florio, P.: Airworthiness: An Introduction to Aircraft Certification. Elsevier Ltd., 2010
	- Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008

Course L1548: Systems Engineerin	Course L1548: Systems Engineering	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Ralf God	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Madula M1161, Turbamaak	sinon			
Module M1161: Turbomach	linery			
Courses				
Title		Тур	Hrs/wk	CP
Turbomachines (L1562)		Lecture	3	4
Turbomachines (L1563)		Recitation Section (large)	1	2
Module Responsible	Prof. Franz Joos			
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	The students can			
	<ul> <li>distinguish the physical phenomena of conversion of energy,</li> </ul>			
	<ul> <li>understand the different mathematic modelling of turbomachinery,</li> </ul>			
	<ul> <li>calculate and evaluate turbomachinery.</li> </ul>			
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
	<ul> <li>discuss in small groups and develop an approach.</li> </ul>			
Autonomy	The students are able to			
	<ul> <li>develop a complex problem self-consistent,</li> </ul>			
	<ul> <li>analyse the results in a critical way,</li> </ul>			
	<ul> <li>analyse the results in a childar way,</li> <li>have an qualified exchange with other students.</li> </ul>			
	• have an quanned exchange with other students.			
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	Energy Systems: Specialisation Energy Systems: Compulsory			
Curricula	Energy Systems: Specialisation Marine Engineering: Elective Compulsory	1		
	Product Development, Materials and Production: Specialisation Product D	evelopment: Elective Compulsory	/	
	Product Development, Materials and Production: Specialisation Productio	n: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials:	Elective Compulsory		

Course L1562: Turbomachines	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Franz Joos
Language	DE
Cycle	SoSe
Content	Topics to be covered will include:
	<ul> <li>Application cases of turbomachinery</li> <li>Fundamentals of thermodynamics and fluid mechanics</li> <li>Design fundamentals of turbomachinery</li> <li>Introduction to the theory of turbine stage</li> <li>Design and operation of the turbocompressor</li> <li>Design and operation of the steam turbine</li> <li>Design and operation of the gas turbine</li> <li>Physical limits of the turbomachines</li> </ul>
Literature	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>



Course L1563: Turbomachines	Course L1563: Turbomachines	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1170: Phenomena	a and Methods in Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Experimental Methods for the Characterization of Materials (L1580)		Lecture	2	3
Phase equilibria and transformations (L15	79)	Lecture	2	3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced	d materials along with their applica	tions in technology, in par	ticular metallic, ceramic
	polymeric, semiconductor, modern composite materials (biomater	ials) and nanomaterials.		
	The shade of the shade to shade the shade of	and a state that the dealer state and a state	Warner and the deather and	
Skills	The students will be able to select material configurations accurately the transmission of the material principles from the mistre to the material of the states of the second se	•		-
	architectural principles from the micro- to the macroscale. The stu select optimum materials combinations depending on the technic	•	i moderni materialis scierice	, which enables them to
	select optimum materials combinations depending on the technic	ar applications.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to de	velop ideas further.		
Autonomy	The students are able to			
	<ul> <li>assess their own strengths and weaknesses.</li> </ul>			
	<ul> <li>define tasks independently.</li> </ul>			
	• denne tasks independentity.			
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	International Management and Engineering: Specialisation II. Pro	duct Development and Production: I	Elective Compulsory	
Curricula	Materials Science: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation F	roduct Development: Elective Comp	oulsory	
	Product Development, Materials and Production: Specialisation F	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	laterials: Compulsory		
	Theoretical Mechanical Engineering: Specialisation Materials Sci	ence: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary (	Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Materials Sci			
	Theoretical Mechanical Engineering: Technical Complementary (	Course: Elective Compulsory		

Course L1580: Experimental Methods for the Characterization of Materials			
Тур	Lecture		
Hrs/wk			
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Patrick Huber		
Language	DE/EN		
Cycle	SoSe		
Content	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>		
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 L1579: Phase equilibria and transformations		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Jörg Weißmüller	
Language	DE	
Cycle	SoSe	
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.	
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.	



## Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Production Systems (L0927)		Problem-based Learning	2	3
Emotional Design / User Centered Produc	t Development (L1703)	Seminar	2	2
Development Management for Mechatroni	cs (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Struc	tures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc	tures (L0501)	Laboratory Course	1	1
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Course (L125	58)	Problem-based Learning	3	3
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Applications	(L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)		Lecture	2	4
Productivity Management (L0928)		Problem-based Learning	2	2
Productivity Management (L0931)		Recitation Section (small)	- 1	1
Feedback Control in Medical Technology (	(L0664)	Lecture	2	3
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	- 1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transportation (L08	855)	Lecture	3	3
	555	Lecture	2	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)			2	2
Materials Testing (L0949)		Lecture		
Reliability in Engineering Dynamics (L0176		Lecture	2	2
Reliability in Engineering Dynamics (L1303	1)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	Students are able to express their extended knowled	ge and discuss the connection of different	special fields or app	lication areas of pro
	development, materials and production			
	<ul> <li>Students are qualified to connect different special fields</li> </ul>	with each other		
Skills				
Skills	Students can apply specialized solution strategies and			
Skills		new scientific methods in selected areas	ution approaches	
Skills	Students can apply specialized solution strategies and	new scientific methods in selected areas	ution approaches	
Skills Personal Competence	Students can apply specialized solution strategies and	new scientific methods in selected areas	ution approaches	
	Students can apply specialized solution strategies and	new scientific methods in selected areas	ution approaches	
Personal Competence Social Competence	Students can apply specialized solution strategies and	new scientific methods in selected areas	ution approaches	
Personal Competence	Students can apply specialized solution strategies and	new scientific methods in selected areas unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence	<ul> <li>Students can apply specialized solution strategies and</li> <li>Students are able to transfer learned skills to new and a</li> </ul>	new scientific methods in selected areas unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence Autonomy	<ul> <li>Students can apply specialized solution strategies and</li> <li>Students are able to transfer learned skills to new and to</li> <li>Students are able to develop their knowledge and skills</li> </ul>	new scientific methods in selected areas unknown problems and can develop own sol	ution approaches	
Personal Competence Social Competence Autonomy Workload in Hours	<ul> <li>Students can apply specialized solution strategies and</li> <li>Students are able to transfer learned skills to new and the students are able to develop their knowledge and skills</li> <li>Depends on choice of courses</li> </ul>	new scientific methods in selected areas unknown problems and can develop own sol s by autonomous election of courses.		
Personal Competence Social Competence Autonomy Workload in Hours Credit points	<ul> <li>Students can apply specialized solution strategies and</li> <li>Students are able to transfer learned skills to new and a</li> <li>Students are able to develop their knowledge and skills</li> <li>Depends on choice of courses</li> <li>6</li> </ul>	new scientific methods in selected areas unknown problems and can develop own sol s by autonomous election of courses. n Product Development: Elective Compulsor		



000136 2133	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in	Independent Study Time 48, Study Time in Lecture 42
Hours	
Examination	Mündliche Prüfung
Form	
Examination	30 Minuten
duration	
and scale	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrated Production Systems		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	not available	
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.	
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.	
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.	
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.	
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.	
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.	
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.	

Course L1703: Emotional Design / User Centered Product Development		
Тур	Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Referat	
Examination duration and scale	Teamarbeit und abschließender Vortrag	
Lecturer	Jörg Heuser	
Language	DE	
Cycle	SoSe	
Content	Lecture     Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization	
Literature	Wird in der Veranstaltung angegeben	



Course L1512: Development Manag	ement for Mechatronics		
• •	Lecture		
Hrs/wk			
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Mündliche Prüfung		
Examination duration and scale	30 Minuten		
Lecturer	Dr. Daniel Steffen		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>		
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>		

Course L0310: Fatigue & Damage T	olerance
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,
	environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
-	WiSe Recommended Decisions Knowledges
Content	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structu used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of application is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining a Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwei structures as well as their application fields.
Literature	
	Lecture Notes and selected papers
	J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International
	<ul> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> </ul>
	<ul> <li>D.A. Grewen, A. Benatat, J.B. Park, Plastics and composites weiging nanobolk</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>

Course L0501: Joining of Polymer-Metal Lightweight Structures		
Тур	Laboratory Course	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Sergio Amancio Filho	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L1514: Lightweight Construe	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	
Content	Fundamentals of Anisotropic Elasticity
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law
	Behaviour of a single laminate layer
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules
	Fundamentals of Micromechanics of a laminate layer
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin
	Bending of Composite Laminated Plates
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions
	Stress Concentration Problems
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis
	Stability of Thin-Walled Composite Structures
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and thei evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> </ul>
	<ul> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	<ul> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.</li> </ul>
	• Turvey, G.J., Marshall, I.H., Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.
	Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
	<ul> <li>getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>Determination of material properties based on sample tests</li> <li>manufacturing of the structure in the composite lab</li> <li>Testing of the developed structure</li> <li>Concept presentation</li> <li>Self-organised teamwork</li> </ul>
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	Aircraft Applications
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements,
	thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	1. Introduction/process of aircraft design/various aircraft configurations
	2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)
	3. Statistical methods in overall aircraft design/data base methods
	4. Principles of aircraft performance design (stability, V-n-diagramme)
	5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)
	6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)
	7. Principles of engine design and integration
	8. Cruise design
	9. Design of runway and landing field length
	10. Cabin design (fuselage dimensioning, cabin interior, loading systems)
	11. System- and equipment aspects
	12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
	Recitation Section (large)
Hrs/wk	1
CP	
Workload in Hours	
Examination Form	
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nancimprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVI LPCVD, DECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching will KQH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensor thermopile and biometry, radiometr)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor; piezoresistive, capacitiv and fabrication process; accelerometer; piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabricatio process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: splining current Hall sensor and magneto-transistor; magnetoresistive sensors; magnetoresistive gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzym electrode, NA chip)</li> <li>Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optic microscanner, microfulices witching elements, micropumps,</li></ul>
Literature	
	N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity Management	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Ulf Pilz, Prof. Olaf Simanski
Language	DE
Cycle	SoSe
Content	<ul> <li>Taking an engineering point of view, the lecture is structured as follows.</li> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000
	NickArdoo, Enyslological Control Cystem, IEEE 11635, 2000



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy			
Тур	Recitation Section (small)		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Examination Form	Klausur		
Examination duration and scale	60 Minuten		
Lecturer	Prof. Martin Kaltschmitt		
Language	)E/EN		
Cycle	SoSe		
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		



Course L1130: Six Sigma				
Тур	ecture			
Hrs/wk				
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Klausur			
Examination duration and scale	90 Minuten			
Lecturer	Prof. Claus Emmelmann			
Language	DE			
Cycle	WiSe			
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul> Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008			
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008			

Course L0855: System Analysis in Air Transportation			
Тур	Lecture		
Hrs/wk	3		
CP			
Workload in Hours	ependent Study Time 48, Study Time in Lecture 42		
Examination Form	Klausur		
Examination duration and scale	60 Minuten		
Lecturer	Dr. Marco Weiss		
Language	DE		
Cycle	WiSe		
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>		
Literature	Hand out		

Course L1513: Technical Design					
Тур	cture				
Hrs/wk	2				
CP	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Examination Form	Hausarbeit				
Examination duration and scale	(Hausarbeit)				
Lecturer	Prof. Werner Granzeier				
Language	DE				
Cycle	SoSe				
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>				
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen				



SC	. "Product Development, Materials and Production"	Technisc
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	
	DRAWING	
	Barons Educational Series	
	ISBN-13: 978-0-7641-6182-7	
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept	
	Presentation for Designers and Illustrators	
	Watson-Guptil Publication a division of Billboard Publications Inc.,	
	New York 1985	
	AIRWORLD	
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
	Perter Deslius Jacek Slaski te Neues 2005	
	Technik und Sicherheit von Passagierflugzeugen	
	Frank Littek	
	Motorbuch Verlag 2003	
	Jetliner Cabins	
	Jennifer Coutts Clay	
	Cs books England 2006	
	BOEING Widebodies	
	Michael Haenggi motorbooks international USA 2003	
	form - Zeitschrift für Gestaltung, Verlag form GmbH,	
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim	
	(erscheint vierteljährlich, Verlag form GmbH)	
	design report	
	german magasin,	
	(erscheint monatlich)	
	md - möbel interior design, Konradin-Verlag	
	Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen	
	(erscheint monatlich)	
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,	
	Kitashinjuku, Shinjuku-ku, Tokio 160, Japan	
	(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland Gm	ıbН,
	Auto & Design,	
	Corso Frabcia 161, 10139 Torino, Italia	
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei	

Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology					
Тур	Lecture				
Hrs/wk	2				
CP	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Examination Form	ausur				
Examination duration and scale					
	r. Rolf Janßen				
Language					
Cycle	liSe				
Content	ntroduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. powder-metauurgical techniques and sintering (solid state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed. Examples will be discussed in order to give angineering students an understanding of technology development and specific applications of ceramic components.				
	Content: 1. Introduction				
	Inhalt: 2. Raw materials				
	3. Powder fabrication				
	4. Powder processing				
	5. Shape-forming processes				
	6. Densification, sintering				
	7. Glass and Cement technology				
	8. Ceramic-metal joining techniques				
Literature	W.D. Kingery, "Introduction to Ceramics", John Wiley & Sons, New York, 1975				
	ASM Engineering Materials Handbook Vol.4 "Ceramics and Glasses", 1991				
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992				
	Skript zur Vorlesung				



Course L0949: Materials Testing			
Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	Idependent Study Time 32, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	10 Minuten		
Lecturer	r. Jan Oke Peters		
Language	DE		
Cycle	WiSe		
Content			
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>		
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill		

Course L0176: Reliability in Engineering Dynamics				
Тур	Lecture			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	Klausur			
Examination duration and scale	90 min.			
Lecturer	Prof. Uwe Weltin			
Language	-N			
Cycle	SoSe			
	Method for calculation and testing of reliability of dynamic machine systems   Modeling  System identification  Simulation  Processing of measurement data Damage accumulation  Test planning and execution			
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 L1303: Reliability in Engineering Dynamics				
Тур	Recitation Section (small)			
Hrs/wk	1			
CP	<b>CP</b> 2			
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14			
Examination Form	Klausur			
Examination duration and scale	Examination duration and scale 90 min			
Lecturer	Prof. Uwe Weltin			
Language	EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			



Course L0749: Reliability of Aircraft Systems				
Тур	Lecture			
Hrs/wk				
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Klausur			
Examination duration and scale	30 Minuten			
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek			
Language	DE			
Cycle	WiSe			
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>			
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>			



Module M1226: Mechanica	Properties				
Courses					
Title		Тур	Hrs/wk	CP	
Mechanical Behaviour of Brittle Materials	L1661)	Lecture	2	3	
Dislocation Theory of Plasticity (L1662)		Lecture	2	3	
Module Responsible	Dr. Erica Lilleodden				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ached the following learning results			
Professional Competence					
Knowledge	Students can explain basic principles of crys	tallography, statics (free body diagrams, tractions)	and thermodynamics (ener	rgy minimization, ener	
	barriers, entropy)				
Skillo	Students are concluded fueing standardized cal	laulation matheday tangar aplaulational derivativas ir	tagrala tangar transformatia	20	
Skills	Skills Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations				
Personal Competence					
Social Competence       Students can provide appropriate feedback and handle feedback on their own performance constructively.         Autonomy       Students are able to					
	- assess their own strengths and weaknesses				
	- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.				
	- assess their own state of learning in specific terms and to define further work steps on this dasis guided by leachers.				
	- work independently based on lectures and notes to solve problems, and to ask for help or clarifications when needed				
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	Materials Science: Core qualification: Compuls	ory			
Curricula	Mechanical Engineering and Management: Specialisation Materials: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Product Development, Materials and Production				



Course L1661: Mechanical Behavior	ur of Brittle Materials	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Gerold Schneider	
Language	DE/EN	
Cycle	SoSe	
Content	Theoretical Strength	
	Of a perfect crystalline material, theoretical critical shear stress	
	Real strength of brittle materials	
	Energy release reate, stress intensity factor, fracture criterion	
	Scattering of strength of brittle materials	
	Defect distribution, strength distribution, Weibull distribution	
	Heterogeneous materials I	
	Internal stresses, micro cracks, weight function,	
	Heterogeneous materials II	
	Toughening mechanisms: crack bridging, fibres	
	erogeneous materials III	
	ghening mechanisms. Process zone	
	Testing methods to determine the fracture toughness of brittle materials	
	surve, stable/unstable crack growth, fractography	
	Thermal shock	
	Subcritical crack growth)	
	v-K-curve, life time prediction	
	Kriechen	
	Mechanical properties of biological materials	
	Examples of use for a mechanically reliable design of ceramic components	
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier	
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998	
	B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993	
	D. Munz, T. Fett, Ceramics, Springer, 2001	
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	

Course L1662: Dislocation Theory of	of Plasticity
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
Content	This class will cover the principles of dislocation theory from a physical metallurgy perspective, providing a fundamental understanding of the relations between the strength and of crystalline solids and distributions of defects.
	We will review the concept of dislocations, defining terminology used, and providing an overview of important concepts (e.g. linear elasticity, stress-strain relations, and stress transformations) for theory development. We will develop the theory of dislocation plasticity through derived stress-strain fields, associated self-energies, and the induced forces on dislocations due to internal and externally applied stresses. Dislocation structure will be discussed, including core models, stacking faults, and dislocation arrays (including grain boundary descriptions). Mechanisms of dislocation multiplication and strengthening will be covered along with general principles of creep and strain rate sensitivity. Final topics will include non-FCC dislocations, emphasizing the differences in structure and corresponding implications on dislocation mobility and macroscopic mechanical behavior; and dislocations in finite volumes.
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen



Modulo M0940: Ontimal an	d Pobuet Control			
Module M0840: Optimal and				
Courses				
Title		Тур	Hrs/wk	CP
Optimal and Robust Control (L0658)		Lecture	2	3
Optimal and Robust Control (L0659)		Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Classical control (frequency response, root locus)			
Knowledge	State space methods			
	Linear algebra, singular value decomposition			
Educational Objectives				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can explain the significance of the matrix Ricc	ati equation for the solution of LQ problems	3.	
	They can explain the duality between optimal state feed	back and optimal state estimation.		
	They can explain how the H2 and H-infinity norms are a	used to represent stability and performance	constraints.	
	They can explain how an LQG design problem can be	formulated as special case of an H2 design	problem.	
	They can explain how model uncertainty can be represented by the second se	sented in a way that lends itself to robust co	ntroller design	
	They can explain how - based on the small gain theore	m - a robust controller can guarantee stabi	lity and performance fo	or an uncertain plant.
	They understand how analysis and synthesis condition	s on feedback loops can be represented as	s linear matrix inequali	ties.
Skills				
entite	<ul> <li>Students are capable of designing and tuning LQG con</li> </ul>	trollers for multivariable plant models.		
	They are capable of representing a H2 or H-infinity de	esign problem in the form of a generalized	plant, and of using st	andard software tools
	solving it.			
	They are capable of translating time and frequency do	omain specifications for control loops into	constraints on closed-	loop sensitivity function
	and of carrying out a mixed-sensitivity design.			
	They are capable of constructing an LFT uncertainty mo		• •	
	They are capable of formulating analysis and synthe     activity they	sis conditions as linear matrix inequalitie	s (LMI), and of using	standard LMI-solvers
	solving them. <ul> <li>They can carry out all of the above using standard software tools (Matlab robust control toolbox).</li> </ul>			
	• They can carry out an of the above using standard solu			
Personal Competence				
Social Competence	Students can work in small groups on specific problems to arriv	ve at joint solutions.		
Autonomy	Students are able to find required information in sources provide	ded (lecture notes, literature, software docu	mentation) and use it t	o solve given problem
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following	Computer Science: Specialisation Intelligence Engineering: El			
Curricula	Electrical Engineering: Specialisation Control and Power Syste	ems: ⊨iective Compulsory		
	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems:			
	Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory			
	Mechatronics: Specialisation mengent Systems and Hobbits Mechatronics: Specialisation System Design: Elective Comput			
	Biomedical Engineering: Specialisation System Design: Liective Comparison Biomedical Engineering: Specialisation Artificial Organs and F		v	
	Biomedical Engineering: Specialisation Attrictar Organis and T Biomedical Engineering: Specialisation Implants and Endopro	•	3	
	Biomedical Engineering: Specialisation Medical Technology a			
	Biomedical Engineering: Specialisation Management and Bus			
	Product Development, Materials and Production: Specialisatio	1 3	ory	
	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio			
	Theoretical Mechanical Engineering: Technical Complementa			



Course L0658: Optimal and Robust	Control			
Тур	Lecture			
Hrs/wk	2			
CP				
Workload in Hours	ependent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Herbert Werner			
Language	EN			
Cycle	SoSe			
Content	<ul> <li>Optimal regulator problem with finite time horizon, Riccati differential equation</li> <li>Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system</li> <li>Kalman's identity, phase margin of LQR controllers, spectral factorization</li> <li>Optimal state estimation, Kalman filter, LQG control</li> <li>Generalized plant, review of LQG control</li> <li>Signal and system norms, computing H2 and H∞ norms</li> <li>Singular value plots, input and output directions</li> <li>Mixed sensitivity design, H∞ loop shaping, choice of weighting filters</li> <li>Case study: design example flight control</li> <li>Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region)</li> <li>Controller synthesis by solving LMI problems, multi-objective design</li> <li>Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty</li> </ul>			
Literature	<ul> <li>Werner, H., Lecture Notes: "Optimale und Robuste Regelung"</li> <li>Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994</li> <li>Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996</li> <li>Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988</li> <li>Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998</li> </ul>			

Course L0659: Optimal and Robust Control		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1343: Fibre-polyn	ner-composites			
Courses				
Title		Тур	Hrs/wk	CP
Structure and properties of fibre-polymer-o	composites (L1894)	Lecture	2	3
Design with fibre-polymer-composites (L1		Lecture	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous	Basics: chemistry / physics / materials science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students can use the knowledge of fiber-reinforced	composites (FRP) and its constituents to	o play (fiber / matrix) an	d define the necessary
	testing and analysis.			
	They can explain the complex relationships structure	-property relationship and		
	the interactions of chemical structure of the polymers	s, their processing with the different fiber	types, including to expla	ain neighboring contexts
	(e.g. sustainability, environmental protection).			
Skills	Students are capable of			
	using standardized coloulation matheda in a give	n contaut to machanical properties (ma	dulua atropath) ta aala	ulate and evaluate the
	- using standardized calculation methods in a give	en context to mechanical properties (mo	duius, strength) to calc	ulate and evaluate the
	different materials.			
	- Approximate sizing using the network theory of the structural elements implement and evaluate.			
	- For mechanical recycling problems selecting appropriate solutions and sizing example Stiffness, corrosion resistance.			
Personal Competence	- For mechanical recycling problems selecting approp	mate solutions and sizing example stime	ss, conosion resistance.	
Personal Competence Social Competence	Students can,			
obcial oblightence				
	- arrive at work results in groups and document them.			
	- provide appropriate feedback and handle feedback of	on their own performance constructively		
Autonomy	Students are able to,	in their own performance constructively.		
hatehenny				
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific terms	and to define further work steps on this ba	asis quided by teachers	
	access their own state of learning in specific terms		teachers.	
	- assess possible consequences of their professional	activity.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
	Energy Systems: Core qualification: Elective Compulsory			
Curricula	Aircraft Systems Engineering: Specialisation Cabin Syste			
	International Management and Engineering: Specialisation	•	Elective Compulsory	
	Materials Science: Specialisation Engineering Materials:			
	Mechanical Engineering and Management: Core qualific Product Development, Materials and Production: Special		ulsory	
	Product Development, Materials and Production: Special Product Development, Materials and Production: Special		uisol y	
	Product Development, Materials and Production: Special			
	Renewable Energies: Specialisation Bioenergy Systems			
	Renewable Energies: Specialisation Solar Energy System			
	Renewable Energies: Specialisation Wind Energy System			
	Theoretical Mechanical Engineering: Specialisation Mate			



Course L1894: Structure and proper	Course L1894: Structure and properties of fibre-polymer-composites		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Bodo Fiedler		
Language	EN		
Cycle	SoSe		
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction		
	- Development of composite materials		
	- Mechanical and physical properties		
	- Mechanics of Composite Materials		
	- Laminate theory		
	- Test methods		
	- Non destructive testing		
	- Failure mechanisms		
	- Theoretical models for the prediction of properties		
	- Application		
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press		
Literature	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press		
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York		

Course L1893: Design with fibre-pol	lymer-composites
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques;
	Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



Module M1344: Processing	of fibre-polymer-composites			
Courses				
Title		Тур	Hrs/wk	CP
Processing of fibre-polymer-composites (	1805)	Lecture	2	3
From Molecule to Composites Part (L1516		Problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler	ŭ		
Admission Requirements	None			
Recommended Previous	Structure and Properties of Polymers			
Knowledge	Structure and Properties of Composites			
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 technica	I details of the manufacturing processes composites	and illustrate respectiv	e relationships. They are
	capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process			
	of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowle	dge on civil engineering to the process of solving p	ractical problems. The	ey identify and overcome
	typical problems during the realization of projects in the context of civil 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-su	bject groups in order to independently derive solu	tions to given probler	ns in the context of civi
	engineering. They are able to effectively present and	d explain their results alone or in groups in front of a	qualified audience. St	udents have the ability to
	develop alternative approaches to an engineering problem independently or in groups and discuss advantages as well as drawbacks.			
Autonomy	Students are capable of independently solving mech	nanical engineering problems using provided literatur	re. They are able to fill	gaps in as well as exten
	their knowledge using the literature and other sou	rces provided by the supervisor. Furthermore, they	can meaningfully exte	end given problems and
	pragmatically solve them by means of corresponding	solutions and concepts.		
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	Materials Science: Specialisation Engineering Mater	ials: Elective Compulsory		
Curricula	Mechanical Engineering and Management: Speciali	sation Materials: Elective Compulsory		
	Product Development, Materials and Production: Sp	ecialisation Product Development: Elective Compulso	ory	
	Product Development, Materials and Production: Sp	ecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Sp	ecialisation Materials: Elective Compulsory		

Course L1895: Processing of fibre-polymer-composites		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler	
Language	DE/EN	
Cycle	SoSe	
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding	
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall	

Course L1516: From Molecule to Co	imposites Part
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective documents (electronically and in conversation). The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made handlebar with approved quality. In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of the final report created (compilation of the results for the "customers"). After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous improvement.
Literature	Customer Request ("Handout")



Module M0563: Robotics				
Courses				
Title		Тур	Hrs/wk	CP
Robotics: Modelling and Control (L0168)		Lecture	3	3
Robotics: Modelling and Control (L1305)		Recitation Section (small)	2	3
Module Responsible	Prof. Uwe Weltin			-
Admission Requirements	None			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Broad knowledge of mechanics			
	Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties of robots an	d solution approaches for multiple proble	ms in robotics.	
Skills	Students are able to derive and solve equations of motion for vario	ous manipulators.		
	Students can generate trajectories in various coordinate systems.			
	Students can design linear and partially nonlinear controllers for r	obotic manipulators.		
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 in	dependently.		
	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 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Computer Science: Specialisation Intelligence Engineering: Election	ve Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Ele	ctive Compulsory		
	Computational Science and Engineering: Specialisation Systems	Engineering and Robotics: Elective Com	oulsory	
	International Production Management: Specialisation Production	Technology: Elective Compulsory		
	International Management and Engineering: Specialisation II. Med	chatronics: Elective Compulsory		
	International Management and Engineering: Specialisation II. Pro	duct Development and Production: Electiv	e Compulsory	
	Mechanical Engineering and Management: Core qualification: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation P	roduct Development: Elective Compulsor	/	
	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation M	aterials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Deve	lopment and Production: Elective Compu	Isory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		

Course L0168: Robotics: Modelling and Control		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Uwe Weltin	
Language	EN	
Cycle	WiSe	
Content	Fundamental kinematics of rigid body systems	
	Newton-Euler equations for manipulators	
	Trajectory generation	
	Linear and nonlinear control of robots	
Literature	Craig, John J.: Introduction to Robotics Mechanics and Control, Third Edition, Prentice Hall. ISBN 0201-54361-3	
	Spong, Mark W.; Hutchinson, Seth; Vidyasagar, M. : Robot Modeling and Control. WILEY. ISBN 0-471-64990-2	



Course L1305: Robotics: Modelling and Control	
Тур	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0771: Flight Phys	ics			
Courses				
Title		Тур	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L0	727)	Lecture	3	3
Flight Mechanics II (L0730)		Lecture	2	2
Flight Mechanics II (L0731)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	a Markana Kan			
	Mathematics			
	Mechanics     The reserves are as a second sec			
	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the for	llowing 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 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation	n II. Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialis	ation Product Development: Elective Compulso	ry	
	Product Development, Materials and Production: Specialis	ation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialis	ation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircra	ft Systems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Compleme	entary Course: Elective Compulsory		

ourse L0727: Aerodynamics and Flight Mechanics I		
Тур	Lecture	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Ralf Heinrich, Mike Montel	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows)</li> <li>Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)</li> </ul>	
Literature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>	



Course L0730: Flight Mechanics II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	<ul> <li>stationary asymmetric flight</li> <li>dynamics of lateral movement</li> <li>methods of flight simulation</li> <li>eyperimental methods of flight mechanics</li> <li>model validation using system identification</li> <li>wind tunnel techniques</li> </ul>
Liefature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>

Course L0731: Flight Mechanics II	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0815: Product Pla	anning			
Courses				
Title		Тур	Hrs/wk	CP
Product Planning (L0851)		Problem-based Learning	3	3
Product Planning (20031) Product Planning Seminar (20853)		Problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt			
Admission Requirements	None			
Recommended Previous	Good basic-knowledge of Business Administration			
Knowledge	dood basic-knowledge of business Administration			
Educational Objectives	After taking part successfully, students have reached the following lea	ming results		
	Alter taking part successionly, students have reached the following lea			
Professional Competence	Chudenta will anim insiskts inter			
Knowledge	Students will gain insights into:			
	Product Planning			
	• Process			
	<ul> <li>Methods</li> </ul>			
	Design thinking			
	<ul> <li>Process</li> </ul>			
	<ul> <li>Methods</li> </ul>			
	<ul> <li>User integration</li> </ul>			
Skills	Students will gain deep insights into:			
	Product Planning			
	<ul> <li>Process-related aspects</li> </ul>			
	<ul> <li>Organisational-related aspects</li> </ul>			
	<ul> <li>Human-Ressource related aspects</li> </ul>			
	<ul> <li>Working-tools, methods and instruments</li> </ul>			
	0			
Personal Competence				
Social Competence	Interact within a team			
	<ul> <li>Raise awareness for globabl issues</li> </ul>			
Autonomy	<ul> <li>Gain access to knowledge sources</li> </ul>			
	Interpret complex cases			
	Develop presentation skills			
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	Global Innovation Management: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation I. Elective			
	Mechanical Engineering and Management: Specialisation Managem			
	Product Development, Materials and Production: Specialisation Production	uct Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation Production:	uction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Mate	ials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Develop		ulsory	
	Theoretical Mechanical Engineering: Technical Complementary Court	se: Elective Compulsory		

Course L0851: Product Planning	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process
	This integrated lecture is designed to understand major issues, activities and tools in the context of systematic product planning, a key activity for managing the front-end of innovation, i.e.:
	Systematic scanning of markets for innovation opportunities
	Understanding strengths/weakness and specific core competences of a firm as platforms for innovation
	<ul> <li>Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.)</li> <li>Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment</li> <li>Transferring ideas for innovation into feasible concepts which have a high market attractively</li> </ul>
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010



Course L0853: Product Planning Seminar		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Cornelius Herstatt	
Language	EN	
Cycle	WiSe	
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly	
Literature	see/siehe Vorlesung Produktplanung/Product Planning	



	ntal Protection and Management			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Pollution Control (L0502)		Lecture	2	2
Health, Safety and Environmental Manage	ment (L0387)	Lecture	2	3
Health, Safety and Environmental Manage	ment (L0388)	Recitation Section (small)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous				
Knowledge	Good knowledge in Technologies for Environment			
	<ul> <li>Good knowledge of the relevant Environmental Le</li> <li>Basic knowledge of instruments for Environmental</li> </ul>	•		
	Basic knowledge of instruments for Environmental	Assessment		
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	The students are able to describe the basics of regulati	ons, economic instruments, voluntary initiatives,	fundamentals of HS	E legislation ISO 140
	EMAS and Responsible Care ISO 14001 requirements. T	hey can analyse and discuss industrial processes	s, substance cycles a	ind approaches from er
	of-pipe technology to eco-efficiency and eco-effectiveness	s, showing their sound knowledge of complex ind	ustry related problem	ns. They are able to jud
	environmental issues and to widely consider, apply or car	ry out innovative technical solutions, remediation	measures and furthe	er interventions as well
	conceptual problem solving approaches in the full range of	of problems in different industrial sectors.		
Skills	Students are able to assess current problems and situat	ions in the field of environmental protection. The	ey can consider the t	oest available techniqu
	and to plan and suggest concrete actions in a company- o	or branch-specific context. By this means they car	solve problems on a	a technical, administrat
	and legislative level.			
Personal Competence				
Social Competence				
	с с ,			
Autonomy	Students are able to organize their work flow to prepare the	nemselves for presentations and contributions to	the discussions. The	v can acquire appropria
hatohony	knowledge by making enquiries independently.			y our acquire appropri
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Energy and Environmental Engineering: Specialisation E	nvironmental Engineering: Elective Compulsory		
Curricula	Environmental Engineering: Core gualification: Compulso			
	Joint European Master in Environmental Studies - Cities a	•	Compulsory	
	Joint European Master in Environmental Studies - Cities a			
	Product Development, Materials and Production: Speciali			
	Product Development, Materials and Production: Speciali		-	
	Product Development, Materials and Production: Speciali			
	Water and Environmental Engineering: Specialisation En			



Course L0502: Integrated Pollution Control		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	The lecture focusses on:   The Regulatory Framework  Pollution & Impacts, Characteristics of Pollutants  Approaches of Integrated Pollution Control  Sevilla Process, Best Available Technologies & BREF Documents	
	<ul> <li>Case Studies: paper industry, cement industry, automotive industry</li> <li>Field Trip</li> </ul>	
	Förstner, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 Shen, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3	

Course L0387: Health, Safety and E	Course L0387: Health, Safety and Environmental Management	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Hans-Joachim Nau	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>	
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP	

purse L0388: Health, Safety and Environmental Management		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hans-Joachim Nau	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0962: Sustainability and Risk Management					
Courses					
Title		Тур	Hrs/wk	CP	
Safety, Reliability and Risk Assessment (L	.1145)	Seminar	2	3	
Environment and Sustainability (L0319)		Lecture	2	3	
Module Responsible	Prof. Kerstin Kuchta				
Admission Requirements	None				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following	g learning results			
Professional Competence					
Knowledge	Students are able to describe single techniques and to give an overview for the field of safety and risk assessment as well as environmental and				
	sustainable engineering, in detail:				
	<ul> <li>basics in safety and reliability of technical facilities</li> </ul>				
	<ul> <li>safety and reliability analysis methods</li> </ul>				
	<ul> <li>salety and reliability analysis methods</li> <li>risk assessment</li> </ul>				
	<ul> <li>Production and usage of bio-char</li> </ul>				
	-				
	<ul> <li>energy production and supply</li> <li>sustainable product design</li> </ul>				
Skills	Students are able apply interdisciplinary system-oriented methor costs for processes and select economically feasible treatment co		nability reporting. They can	evaluate the effort and	
Personal Competence					
Social Competence					
Autonomy	Students can gain knowledge of the subject area from given so	urces and transform it to new ques	tions. Furthermore, they car	n define targets for new	
	application or research-oriented duties in for risk management a		•	÷	
	impact.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written elaboration				
Examination duration and scale	Elaboration and presentation (45 minutes in groups)				
Assignment for the Following	Civil Engineering: Core qualification: Compulsory				
Curricula	International Management and Engineering: Specialisation II. Civ	ril Engineering: Elective Compulsor	/		
	Product Development, Materials and Production: Specialisation F				
	Product Development, Materials and Production: Specialisation F				
	Product Development, Materials and Production: Specialisation				
	Water and Environmental Engineering: Core qualification: Comp				
	water and Environmental Engineering: Core qualification: Comp	uisory			

Course L1145: Safety, Reliability and Risk Assessment		
Тур	Seminar	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Marco Ritzkowski	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated:</li> <li>basics in safety and reliability of technical facilities</li> <li>safety and reliability analysis methods</li> <li>risk assessment</li> <li>practical examples and excursions</li> <li>discussions and presentations</li> </ul>	
Literature	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>	



Course L0319: Environment and Sustainability			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Kerstin Kuchta		
Language	EN		
Cycle	WiSe		
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of		
	energy supply, product design, water supply, waste water treatment or mobility. The following list show examples.		
	Production and Usage of Bio-char		
	Engergy production with algae		
	Environmental product design		
	Clean Development mechanism (CDM)		
	Democracy and Energy		
	New Concepts for a sustainable Energy Supply		
	Recycling of Wind Turbines		
	Alternative Mobility		
	Disposal of Nuclear Wastes		
	Waste2Energy		
	Offshore Wind energy		
Literature	Wird in der Veranstaltung bekannt gegeben.		



Module M1002: Production	and Logistics Management			
Courses				
litle		Тур	Hrs/wk	CP
Dperative Production and Logistics Manag	ement (L1198)	Lecture	2	2
Strategic Production and Logistics Manage		Problem-based Learning	3	4
Module Responsible	Prof. Wolfgang Kersten			
Admission Requirements	None			
Recommended Previous	Introduction to Business and Management			
Knowledge				
	The province knowledge, that is personally for the successful r	articipation in this module is accessible vi	a a looming Log in a	nd additional information
	The previous knowledge, that is necessary for the successful p will be distributed during the admission process.	ancipation in this module is accessable via	a e-leanning. Log-in a	nu auditional informa
	will be distributed during the admission process.			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students will be able			
	- to differentiate between strategic and operational production	and logistics management,		
	- to describe the areas of production and logistics manageme	nt,		
	- understand the difference between traditional and new cond			
	- to describe and explain the actual challenges of production	and logistics management, esp. in an intern	ational context.	
Skills				
	Based on the acquired knowledge students are capable of			
	- Applying methods of production and logistics management	n an international context,		
	- Selecting sufficient methods of production and logistics man	agement to solve practical problems,		
	- Selecting appropriate methods of production and logistics m	anagement also for non-standardized prob	lems,	
	- Making a holistic assessment of areas of decision in produc	tion and logistics management and relevant	t influence factors.	
Personal Competence				
Social Competence	After completion of the module students can			
	<ul> <li>lead discussions and team sessions,</li> </ul>			
	- arrive at work results in groups and document them,			
	- develop joint solutions in mixed teams and present them to	others,		
<b>1</b>	- present solutions to specialists and develop ideas further.			
Autonomy	After completion of the module students can			
	- assess possible consequences of their professional activity,			
	- define tasks independently, acquire the requisite knowledge a	and use suitable means of implementation		
	- denne tasse independentity, acquire the requisite knowledge a	מוס נוסט שמות הפמוש לו הווויויוויוויוומוומוומוו,		
	- define and carry out research tasks bearing in mind possible	societal consequences.		
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	International Management and Engineering: Core qualification	Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Compu			
ourioua	Product Development, Materials and Production: Specialisation		rv	
	Product Development, Materials and Production: Specialisation		,	
	Product Development, Materials and Production: Specialisation			



Course L1198: Operative Production and Logistics Management		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thorsten Blecker	
Language	DE	
Cycle	WiSe	
Content	Further knowledge of operational production management	
	Traditional production planning and control concepts	
	<ul> <li>Recent production planning and control concepts</li> <li>Understanding and application of quantitative methods</li> </ul>	
	Further concepts regarding operational production management	
Literature		
	Corsten, H.: Produktionswirtschaft: Einführung in das industrielle Produktionsmanagement, 12. Aufl., München 2009.	
	Dyckhoff, H./Spengler T.: Produktionswirtschaft: Eine Einführung, 3. Aufl., Berlin Heidelberg 2010.	
	Heizer, J./Render, B: Operations Management, 10. Auflage, Upper Saddle River 2011.	
	Kaluza, B./Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in Virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.	
	Kaluza, B./Blecker, Th. (Hrsg.): Erfolgsfaktor Flexibilität. Strategien und Konzepte für wandlungsfähige Unternehmen, Berlin 2005.	
	Kurbel, K.: Produktionsplanung und steuerung, 5., Aufl., München - Wien 2003.	
	Schweitzer, M.: Industriebetriebslehre, 2. Auflage, München 1994.	
	Thonemann, Ulrich (2005): Operations Management, 2. Aufl., München 2010.	
	Zahn, E./Schmid, U.: Produktionswirtschaft I: Grundlagen und operatives Produktionsmanagement, Stuttgart 1996	
	Zäpfel, G.: Grundzüge des Produktions- und Logistikmanagement, 2. Aufl., München - Wien 2001	



Тур	Problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	WiSe
Content	<ul> <li>Identification of the scope of production, operations and logistics management</li> <li>Understanding of actual challenges concerning production and logistics strategy</li> <li>Understanding operations as a competitive weapon</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategy capacity strategy) of a company</li> <li>Evaluation of operation strategies of different companies and industrial sectors</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of lean management: Main goals and measures of lean management and lean production concepts, impact of lear management on production strategy</li> <li>Presentation and discussion of current research topics in the field of production and logistics management</li> <li>Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills</li> </ul>
Literature	Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung in das industrielle Produktionsmanagement, 12. Auflage, München: Oldenbourg.
	Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.
	Heizer, J/Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.
	Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.
	Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Verlag.
	Slack, N./ Lewis, M.(2002): Operations Strategy, Harlow u.a.
	Swink, M./ Melnyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a.
	Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Computers in Industry 19, S. 79-88
	Womack, J./ Jones, D./ Roos, D. (1990): The Machine that changed the world; New York.
	Zahn, E. /Schmid, U. (1996): Grundlagen und operatives Produktionsmanagement, Stuttgart: Lucius & Lucius
	Zäpfel, G.(2000): Produktionswirtschaft: Strategisches Produktions-Management, 2. Aufl., München u.a.



Module M1024: Methods of	Integrated Product Development			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Product Development II (L1254	)	Lecture	3	3
Integrated Product Development II (L1255		Problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause	5		
Admission Requirements	None			
Recommended Previous	Basic knowledge of Integrated product development and apply	ing CAE systems		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After passing the module students are able to:			
	<ul> <li>explain technical terms of design methodology,</li> </ul>			
	describe essential elements of construction manageme	nt,		
	describe current problems and the current state of researched	arch of integrated product development.		
Skills	After passing the module students are able to:			
	<ul> <li>select and apply proper construction methods for non-si</li> </ul>	andardized solutions of problems as well a	as adapt new boundar	v conditions.
	<ul> <li>solve product development problems with the assistance</li> </ul>		ao adaptinon boundar.	y contaitionito,
	<ul> <li>choose and execute appropriate moderation techniques</li> </ul>			
		-		
Personal Competence				
Social Competence	After passing the module students are able to:			
	<ul> <li>prepare and lead team meetings and moderation proce</li> </ul>	sses,		
	<ul> <li>work in teams on complex tasks,</li> </ul>			
	<ul> <li>represent problems and solutions and advance ideas.</li> </ul>			
Autonomy	After passing the module students are able to:			
	<ul> <li>give a structured feedback and accept a critical feedback</li> </ul>	k		
	<ul> <li>implement the accepted feedback autonomous.</li> </ul>	· ·,		
	· · ·			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 Minuten			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Cabin Systems: E			
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation			
	International Management and Engineering: Specialisation II. F		tive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compuls	•		
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Technical Complementar			
	Theoretical Mechanical Engineering: Specialisation Product De	evelopment and Production: Elective Comp	oulsory	



Course L1254: Integrated Product D	evelopment II
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Lecture
	The lecture extends and enhances the learned content of the module "Integrated Product Development and lightweight design" and is based on the knowledge and skills acquired there.
	Topics of the course include in particular:
	Methods of product development,
	Presentation techniques,
	Industrial Design,
	Design for variety
	Modularization methods,
	Design catalogs,
	Adapted QFD matrix,
	Systematic material selection,
	Assembly oriented design,
	Construction management
	CE mark, declaration of conformity including risk assessment,
	Patents, patent rights, patent monitoring
	<ul> <li>Project management (cost, time, quality) and escalation principles,</li> </ul>
	Development management for mechatronics,
	Technical Supply Chain Management.
	Exercise (PBL)
	In the exercise the content presented in the lecture "Integrated Product Development II" and methods of product development and design managemen will be enhanced.
	Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and current existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussion and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	- Andressen MM Design for Assembly Design Conjugate 1005
	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.     Arbhy, M.F.: Materials Calation in Machanical Design, Müschen, Cashtyrr, 2007.
	Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.
	<ul> <li>Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.</li> <li>Hartmann, M., Bisson, M., Funk, P., Bath, H.: Zielangishtet medicingan, Ein Handhuch für Eührungskräfte, Bereter und Trainer, Weisheim, Bell</li> </ul>
	<ul> <li>Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch f ür F ührungskr äfte, Berater und Trainer, Weinheim, Beli 2007.</li> </ul>
	2007. A Dalia Wulfanata di analatra Dadia Cariana 2000
	Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.
	Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000.
	• Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.

Course L1255: Integrated Product E	Course L1255: Integrated Product Development II	
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Module M1025: Fluidics				
Courses				
<b>Title</b> Fluidics (L1256) Fluidics (L1371)		<b>Typ</b> Lecture Problem-based Learning	Hrs/wk 2 1	<b>CP</b> 3 2
Fluidics (L1257)	Prof. Dieter Krause	Recitation Section (large)	1	1
Module Responsible	None			
Admission Requirements Recommended Previous	Good knowledge of mechanics (stereo statics, elastostatics, hydro	statics, kinematics and kinetics), fluid m	echanics and engine	ring design
Knowledge		states, knemates and knetes), into m	echanics, and enginee	ning 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			
	<ul> <li>explain structures and functionalities of hydrostatic, pneum</li> <li>explain the interaction of hydraulic components in hydrauli</li> <li>explain open and closed loop control of hydraulic systems,</li> <li>describe functioning and applications of hydrodynamic to plant technology</li> </ul>	c systems,	is well as centrifugal p	umps and aggregates
Skills	After passing the module students are able to <ul> <li>analyse and assess hydraulic and pneumatic components</li> <li>design and dimension hydraulic systems for mechanical apperform numerical simulations of hydraulic systems based</li> <li>select and adapt pump characteristic curves for hydraulic s</li> <li>dimension hydrodynamic torque converters and brakes for</li> </ul>	oplications, on abstract problem definitions, ystems		
Personal Competence				
Social Competence	After passing the module students are able to			
	<ul> <li>discuss and present functional context in groups,</li> <li>organise teamwork autonomously.</li> </ul>			
Autonomy	After passing the module students are able to			
	obtain necessary knowledge for the simulation.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Med International Management and Engineering: Specialisation II. Prov Product Development, Materials and Production: Specialisation Pr Product Development, Materials and Production: Specialisation Pr Product Development, Materials and Production: Specialisation M	duct Development and Production: Elec oduct Development: Compulsory oduction: Elective Compulsory	tive Compulsory	
	Theoretical Mechanical Engineering: Specialisation Product Deve Theoretical Mechanical Engineering: Technical Complementary C	lopment and Production: Elective Comp	oulsory	



ourse L1256: Fluidics	
Тур	Lecture
	2
	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Dieter Krause
	DE
-	WiSe
Content	Lecture
	Hydrostatics
	physical fundamentals
	hydraulic fluids
	hydrostatic machines     valves
	components     hydrostatic transmissions
	examples from industry
	- examples non-industry
	Pneumatics
	generation of compressed air
	pneumatic motors
	Examples of use
	Hydrodynamics
	physical fundamentals
	hydraulic continous-flow machines
	hydrodynamic transmissions
	interoperation of motor and transmission
	Exercise
	Hydrostatics
	reading and design of hydraulic diagrams
	dimensioning of hydrostatic traction and working drives
	performance calculation
	Hydrodynamics
	calculation / dimensioning of hydrodynamic torque converters
	calculation / dimensioning of centrifugal pumps
	creating and reading of characteristic curves of pumps and systems
	Field trip
	field trip to a regional company from the hydraulic industry.
	Exercise
	Numerical simulation of hydrostatic systems
	getting to know a numerical simulation environment for hydraulic systems
	transformation of a task into a simulation model
	simulation of common components
	variation of simulation parameters     using simulations for system dimensioning and optimisation
	using simulations for system dimensioning and optimisation
	(partly) self-organised teamwork
Literature	Bücher
	- Museula # 11, Osnalla estada - Euldeshalla - Tall 4, 11 des 19, Obstant Mades Assistant - 2014
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011     Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 0: Desuratik, Shaker Verlag, Aachen, 2000
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006     Matthias, H. L. Banius, K. Th.: Eisführung in die Ölbudrgulik, Taubaar Vorlag, 2006
	<ul> <li>Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006</li> <li>Beitz, W., Grote, KH.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage</li> </ul>
	<ul> <li>שפוע, אי, סוטופ, הח שטטפו - raschenbuch un den Maschinenbau, Springer-verlag, Berlin, aktuelle Autiage</li> </ul>



Course L1371: Fluidics	
Тур	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course
Course L1257: Fluidics	
Тур	Becitation Section (Jarge)

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

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Module M1155: Aircraft Cal	oin Svstems			
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
Educational Obj	After dell'estantico de la construcción de la della	for the other second to		
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and cabin			
	explain the functional and non-functional requirements for ca			
	elucidate the necessity of cabin operating systems and emer			
	<ul> <li>assess the challenges human factors integration in a cabin e</li> </ul>	nvironment		
Skills	Students are able to:			
	<ul> <li>design a cabin layout for a given business model of an Airling</li> </ul>	9		
	design cabin systems for safe operations			
	<ul> <li>design emergency systems for safe man-machine interaction</li> </ul>			
	<ul> <li>solve comfort needs and entertainment requirements in the c</li> </ul>	abin		
Personal Competence				
Social Competence	Students are able to:			
	understand existing system solutions and discuss their ideas	with experts		
Autonomy	Students are able to:			
	Reflect the contents of lectures and expert presentations self	dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Elective Con	npulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory			
	International Management and Engineering: Specialisation II.			
	Product Development, Materials and Production: Specialisation	n Product Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy	stems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementa	ry Course: Elective Compulsory		



Course L1545: Aircraft Cabin Syste	ms
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved.
	The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999</li> <li>Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014</li> <li>Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008</li> <li>Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003</li> <li>Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006</li> <li>Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006</li> </ul>

Course L1546: Aircraft Cabin Syste	ourse L1546: Aircraft Cabin Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module Manual M. Sc. "Product Development, Materials and Production"



Module M1342: Polymers				
Courses				
Title		Тур	Hrs/wk	CP
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Processing and design with polymers (L18		Lecture	2	3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous	Basics: chemistry / physics / material science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	Students can use the knowledge of plastics and defin	e the necessary testing and analysis.		
	They can explain the complex relationships structure-	property relationship and		
	the interactions of chemical structure of the polymers	, including to explain neighboring context	s (e.g. sustainability, env	ironmental protection).
Skills	Students are capable of			
	- using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials.			
	- For mechanical recycling problems selecting appropriate solutions and sizing example Stiffness, corrosion resistance.			
Personal Competence				
Social Competence	Students can,			
	- arrive at work results in groups and document them.			
	- provide appropriate feedback and handle feedback o	n their own performance constructively.		
Autonomy	Students are able to,			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.			
	- assess possible consequences of their professional	activity.		
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	Materials Science: Specialisation Engineering Materials:			
Curricula	Biomedical Engineering: Specialisation Implants and End			
	Biomedical Engineering: Specialisation Artificial Organs a			
	Biomedical Engineering: Specialisation Management and		-	
	Biomedical Engineering: Specialisation Medical Technology	ogy and Control Theory: Elective Compulsor	ry	
	Product Development, Materials and Production: Speciali	sation Production: Elective Compulsory		
	Product Development, Materials and Production: Speciali	sation Materials: Elective Compulsory		
	Product Development, Materials and Production: Speciali	sation Product Development: Elective Comp	oulsory	
	Theoretical Mechanical Engineering: Specialisation Mate	rials Science: Elective Compulsory		



Course L0389: Structure and Properties of Polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
	Dr. Hans Wittich	
Language		
Cycle	WiSe	
Content	- Structure and properties of polymers	
	- Structure of macromolecules	
	Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution	
	- Morphology	
	amorph, crystalline, blends	
	- Properties	
	Elasticity, plasticity, viscoelacity	
	- Thermal properties	
	- Electrical properties	
	- Theoretical modelling	
	- Applications	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	

Course L1892: Processing and design with polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich	
Language	DE/EN	
Cycle	WiSe	
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining	
	Designing with Polymers: Materials Selection; Structural Design; Dimensioning	
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag	
	Crawford: Plastics engineering, Pergamon Press	
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag	
	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Nodule M1185: Technical (	Complementary Course for PEPMS (according to Subject Specific Regulations)
Courses	
<b>Fitle</b>	Typ Hrs/wk CP
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	See selected module according to FSPO
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Examination	according to Subject Specific Regulations
Examination duration and scale	
Assignment for the Following	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory
Curricula	Product Development, Materials and Production: Specialisation Production: Elective Compulsory
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory



## **Specialization Materials**

Graduates of the discipline materials are able to work in the development, production and application of materials based on a natural scientific education. The material-oriented graduates can identify new fields of application and make the application-specific selection of the material under consideration of function, costs and quality.

Module M0763: Aircraft Sys	tems I			
Courses				
Litle		Typ	Hrs/wk	CP
Aircraft Systems I (L0735)		Typ Lecture	3	4
Aircraft Systems I (L0739)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke	······································		
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	U U			
-	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Hydraulics			
	Control Systems			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to:			
	Describe essential components and design po	pints of hydraulic electrical and high-lift systems		
	<ul> <li>Give an overview of the functionality of air con</li> </ul>			
	<ul> <li>Explain the need for high-lift systems such as i</li> </ul>			
	<ul> <li>Assess the challenge during the design of sup</li> </ul>			
Skills	Students are able to:			
	Design hydraulic and electric supply systems	of aircrafts		
	<ul> <li>Design hydraulic and electric supply systems</li> <li>Design high-lift systems of aircrafts</li> </ul>			
	Analyze the thermodynamic behaviour of air c	anditioning systems		
Personal Competence				
Social Competence	Students are able to:			
	Perform system design in groups and present	and discuss results		
Autonomy	Students are able to:			
	Reflect the contents of lectures autonomously			
	Independent Study Time 110, Study Time in Lecture 7	/0		
Credit points	Written exam			
Examination Examination duration and scale	165 Minutes			
	Energy Systems: Specialisation Energy Systems: Elec	ative Compulsory		
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Corr			
Curricula	Anoran Oystems Engineering. Oure qualification: Con	ipuisoi y		
Curricula	International Management and Engineering: Special	eation II Aviation Systems: Elective Compulsory		
Curricula	International Management and Engineering: Specialis	, , ,	ory	
Curricula	Product Development, Materials and Production: Spe	cialisation Product Development: Elective Compuls	ory	
Curricula	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	cialisation Product Development: Elective Compuls cialisation Production: Elective Compulsory	ory	
Curricula	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	cialisation Product Development: Elective Compuls cialisation Production: Elective Compulsory cialisation Materials: Elective Compulsory	ory	
Curricula	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	cialisation Product Development: Elective Compuls cialisation Production: Elective Compulsory cialisation Materials: Elective Compulsory Aircraft Systems Engineering: Elective Compulsory	ory	



Course L0735: Aircraft Systems I	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>

Course L0739: Aircraft Systems I	Course L0739: Aircraft Systems I	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



## Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Production System	ns (L0927)	Problem-based Learning	2	3
Emotional Design / User Centered Produc	t Development (L1703)	Seminar	2	2
Development Management for Mechatron	ics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Strue	ctures (L0500)	Lecture	2	2
loining of Polymer-Metal Lightweight Strue	ctures (L0501)	Laboratory Course	1	1
ightweight Construction with Fibre Reinfo	prced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
ightweight Construction with Fibre Reinfo	prced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
ightweight Design Practical Course (L12	58)	Problem-based Learning	3	3
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Applications	(L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Aicrosystems Technology (L0724)		Lecture	2	4
Productivity Management (L0928)		Problem-based Learning	2	2
Productivity Management (L0931)		Recitation Section (small)	1	- 1
Feedback Control in Medical Technology	(10664)	Lecture	2	3
Renewable Energy (L0313)	(20004)	Lecture	2	2
		Recitation Section (small)		1
Renewable Energy (L1434)			1	-
Six Sigma (L1130)	255)	Lecture	2	3
System Analysis in Air Transportation (L0	855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynamics (L0176	6)	Lecture	2	2
Reliability in Engineering Dynamics (L1303	3)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge				
Kilowicage	Students are able to express their extended knowled	ge and discuss the connection of different	special fields or app	lication areas of pro
	development, materials and production			
	<ul> <li>Students are qualified to connect different special fields</li> </ul>	s with each other		
Skills				
	<ul> <li>Students can apply specialized solution strategies and</li> </ul>	new scientific methods in selected areas		
	Students are able to transfer learned skills to new and a	unknown problems and can develop own sol	ution approaches	
Personal Competence				
Social Competence	-			
Autonomy				
hatonomy	<ul> <li>Students are able to develop their knowledge and skills by autonomous election of courses.</li> </ul>			
Workload in Hours	Depends on choice of courses			
Credit points	12			
Assignment for the Following	Product Development, Materials and Production: Specialisatio	n Product Development: Elective Compulsor	V	
			у	
Curricula	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio	n Materials: Elective Compulsory		



Course L1592: Applied Automation		
Тур	Problem-based Learning	
Hrs/wk	3	
CP	3	
Workload in	Independent Study Time 48, Study Time in Lecture 42	
Hours		
Examination	Mündliche Prüfung	
Form		
Examination	30 Minuten	
duration		
and scale		
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy	
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992	

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrated Production Systems			
Тур	Problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	90 Minuten		
Lecturer	Prof. Hermann Lödding		
Language	DE		
Cycle	SoSe		
Content	not available		
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.		
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.		
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.		
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.		
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.		
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.		
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.		

Course L1703: Emotional Design / User Centered Product Development	
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	<ul> <li>Lecture</li> <li>Objective and subjective perception for the evaluation of product characteristics</li> <li>Effects of material, color, shape and structure to the acceptance of a product</li> <li>Aesthetic function of a product</li> <li>Case studies, lack of acceptance of a product and possible reason</li> <li>Seminar</li> <li>Identification of non-technical product functions</li> <li>Identification of subjective influences for the product development</li> <li>Project Work</li> <li>Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated</li> <li>Exemplary Project: Holistic product evaluation, product optimization</li> </ul>
Literature	Wird in der Veranstaltung angegeben
Literature	Wird in der Veranstaltung angegeben



Course L1512: Development Manag	ement for Mechatronics
• •	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>

Course L0310: Fatigue & Damage Tolerance	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,
	environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989



СР	2
Washlaadin Hausa	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
	90 Minuten
	Prof. Sergio Amancio Filho
	EN WiSe
	Recommended Previous Knowledge:
Content	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structure used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of application is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining a Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwei structures as well as their application fields.
Literature	
Literature	Lecture Notes and selected papers
	J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International
	<ul> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> </ul>
	<ul> <li>D.A. Grewen, A. Bernata, J.B. Park, Plastics and Composites weiging Participok</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1514: Lightweight Construe	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe Final Andread Statistics
Content	Fundamentals of Anisotropic Elasticity
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law
	Behaviour of a single laminate layer
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules
	Fundamentals of Micromechanics of a laminate layer
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin
	Bending of Composite Laminated Plates
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions
	Stress Concentration Problems
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis
	Stability of Thin-Walled Composite Structures
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and thei evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> </ul>
	<ul> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	<ul> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.</li> </ul>
	• Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.
	Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
	<ul> <li>getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>Determination of material properties based on sample tests</li> <li>manufacturing of the structure in the composite lab</li> <li>Testing of the developed structure</li> <li>Concept presentation</li> <li>Self-organised teamwork</li> </ul>
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
literature	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	Aircraft Applications
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements, thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	<ol> <li>Introduction/process of aircraft design/various aircraft configurations</li> <li>Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)</li> <li>Statistical methods in overall aircraft design/data base methods</li> <li>Principles of aircraft performance design (stability, V-n-diagramme)</li> <li>Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)</li> <li>Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)</li> <li>Principles of engine design and integration</li> <li>Cruise design</li> <li>Design of runway and landing field length</li> <li>Cabin design (fuselage dimensioning, cabin interior, loading systems)</li> <li>System- and equipment aspects</li> <li>Design variations and operating cost calculation</li> </ol>
Literature	J. Roskam: "Airplane Design" D.P. Raymer: "Aircraft Design - A Conceptual Approach" J.P. Fielding: "Intorduction to Aircraft Design" Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Courses 1.0004. Airerett Declary I	
Course L0834: Aircraft Design I	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (water fabrication, photolithography, improving resolution, next-generation lithography, nancimprinting, molecular imprinting)</li> <li>Deposition Technology Basics, Lithography (water fabrication, photolithography, improving resolution, next-generation lithography, nancimprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVT LPCVD, PECVD and LECVD; screen printing)</li> <li>Eiching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching will KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, RIE, Bosch process, IX6P2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LICA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensor thermo resistor, Pt-100, spreading resistance sensor, pi junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometri IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnet resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor, metal oxide semiconductor gas sensor, clark electrode, enzym electrok.enzym electrok.phi)</li> <li>Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electr</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity Management	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Ulf Pilz, Prof. Olaf Simanski
Language	DE
Cycle	SoSe
Content	<ul> <li>Taking an engineering point of view, the lecture is structured as follows.</li> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000
L	Michardiour Hydrologiodi Conton Cystelli , IEEE 1 1833, 2000



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> <li>Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008</li> </ul>
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L0855: System Analysis in A	Air Transportation
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>
Literature	Hand out

Hrs/wk 2 CP 3	3 Independent Study Time 62, Study Time in Lecture 28
Hrs/wk 2 CP 3 Workload in Hours 1	2 3 Independent Study Time 62, Study Time in Lecture 28
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Hausarbeit
Examination duration and scale (	(Hausarbeit)
Lecturer F	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
1	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



ЗC	. "Product Development, Materials and Production"	Technisc
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	
	DRAWING	
	Barons Educational Series	
	ISBN-13: 978-0-7641-6182-7	
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept	
	Presentation for Designers and Illustrators	
	Watson-Guptil Publication a division of Billboard Publications Inc.,	
	New York 1985	
	AIRWORLD	
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
	Perter Deslius Jacek Slaski te Neues 2005	
	Technik und Sicherheit von Passagierflugzeugen	
	Frank Littek	
	Motorbuch Verlag 2003	
	Jetliner Cabins	
	Jennifer Coutts Clay	
	Cs books England 2006	
	BOEING Widebodies	
	Michael Haenggi motorbooks international USA 2003	
	form - Zeitschrift für Gestaltung, Verlag form GmbH,	
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim	
	(erscheint vierteljährlich, Verlag form GmbH)	
	design report	
	german magasin,	
	(erscheint monatlich)	
	md - möbel interior design, Konradin-Verlag	
	Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen	
	(erscheint monatlich)	
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,	
	Kitashinjuku, Shinjuku-ku, Tokio 160, Japan	
	(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland Gm	bH,
	Auto & Design,	
	Corso Frabcia 161, 10139 Torino, Italia	
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei	

Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technolog	gy
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
	Dr. Rolf Janßen
Language	
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed. Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.
	Content: 1. Introduction
	Inhalt: 2. Raw materials
	3. Powder fabrication
	4. Powder processing
	5. Shape-forming processes
	6. Densification, sintering
	7. Glass and Cement technology
	8. Ceramic-metal joining techniques
Literature	W.D. Kingery, "Introduction to Ceramics", John Wiley & Sons, New York, 1975
	ASM Engineering Materials Handbook Vol.4 "Ceramics and Glasses", 1991
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung



Course L0949: Materials Testing		
Тур	Lecture	
Hrs/wk	x 2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Dr. Jan Oke Peters	
Language	DE	
Cycle	WiSe	
Content		
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>	
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill	

Course L0176: Reliability in Engineering Dynamics		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 min.	
Lecturer	Prof. Uwe Weltin	
Language	EN	
Cycle	SoSe	
	Method for calculation and testing of reliability of dynamic machine systems   Modeling  System identification  Simulation  Processing of measurement data Damage accumulation  Test planning and execution	
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 L1303: Reliability in Engineering Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 min
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0749: Reliability of Aircraft Systems		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>	
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>	



## Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Production Systems (L0927)		Problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)		Seminar	2	2
Development Management for Mechatronics (L1512)		Lecture	2	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Struc	ctures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc	ctures (L0501)	Laboratory Course	1	1
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fibre Reinfo	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Course (L12	58)	Problem-based Learning	3	3
Mechanisms, Systems and Processes of	Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Applications	(L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)		Lecture	2	4
Productivity Management (L0928)		Problem-based Learning	2	2
Productivity Management (L0931)		Recitation Section (small)	- 1	- 1
Feedback Control in Medical Technology	(L0664)	Lecture	2	3
Renewable Energy (L0313)	()	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	-
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transportation (LO	855)	Lecture	3	3
	555)	Lecture	2	3
Technical Design (L1513)			2	3
Ceramics Technology (L0379)		Lecture		-
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynamics (L0176		Lecture	2	2
Reliability in Engineering Dynamics (L1303	3)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students are able to express their extended knowledge	and discuss the connection of different	special fields or app	lication areas of prod
	development, materials and production			
	<ul> <li>Students are qualified to connect different special fields v</li> </ul>	vith each other		
Skills	<b>.</b>			
	<ul> <li>Students can apply specialized solution strategies and new</li> </ul>			
	<ul> <li>Students are able to transfer learned skills to new and un</li> </ul>	known problems and can develop own sol	ution approaches	
<b>D</b>				
Personal Competence				
Social Competence	-			
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the Following	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulsor	/	
			,	
Curricula	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		



000130 2100	ourse L1592: Applied Automation		
Тур	Problem-based Learning		
Hrs/wk	3		
CP	3		
Workload in	Independent Study Time 48, Study Time in Lecture 42		
Hours			
Examination	Mündliche Prüfung		
Form			
Examination	30 Minuten		
duration			
and scale			
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	SoSe		
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy		
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992		

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	



Course L0927: Elements of Integrated Production Systems		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	not available	
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003.	
	Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993.	
	Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009.	
	Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006.	
	Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001.	
	Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006.	
	Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.	

Тур	Seminar	
Typ Hrs/wk		
CP	2	
Examination Form	Referat	
Examination duration and scale	Teamarbeit und abschließender Vortrag	
Lecturer	Jörg Heuser	
Language	DE	
Cycle	SoSe	
Content	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization	
Literature	Wird in der Veranstaltung angegeben	



Course L1512: Development Manag	ement for Mechatronics	
Тур		
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale	30 Minuten	
Lecturer	Dr. Daniel Steffen	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Processes and methods of product development - from idea to market launch         <ul> <li>identification of market and technology potentials</li> <li>development of a common product architecture</li> <li>Synchronized product development across all engineering disciplines</li> <li>product validation incl. customer view</li> </ul> </li> <li>Steering and optimization of product development         <ul> <li>Design of processes for product development</li> <li>IT systems for product development</li> <li>Establishment of management standards</li> <li>Typical types of organization</li> </ul> </li> </ul>	
Literature	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>	

Course L0310: Fatigue & Damage Tolerance	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength,
	environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur
	Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989



Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN MEC-
Cycle	
Content	Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structu used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of application is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining a Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightwe structures as well as their application fields.
Literature	Lecture Notes and selected papers
	<ul> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> </ul>
	J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers
	D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook
	D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1514: Lightweight Construe	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	
Cycle	WiSe
Content	Fundamentals of Anisotropic Elasticity
	Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law
	Behaviour of a single laminate layer
	Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress Transformation rules
	Fundamentals of Micromechanics of a laminate layer
	Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin
	Bending of Composite Laminated Plates
	Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions
	Stress Concentration Problems
	Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis
	Stability of Thin-Walled Composite Structures
	Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and thei evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> </ul>
	<ul> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	• Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.
	• Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.
	Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1515: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
Literature	getting familiar with fibre reinforced plastics as well as lightweight design     Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)     Determination of material properties based on sample tests     manufacturing of the structure in the composite lab     Testing of the developed structure     Concept presentation     Self-organised teamwork     Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.
	<ul> <li>Schultman, H., "Indnäuderen mit räser Kunsstoller verbänden", opringer, bernin, 2000.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies
1 Bandun	<ul> <li>Stress-strain relationships</li> <li>Strain gauge application</li> <li>Visko elastic behavior</li> <li>Tensile test (strain hardening, necking, strain rate)</li> <li>Compression test, bending test, torsion test</li> <li>Crack growth upon static loading (J-Integral)</li> <li>Crack growth upon cyclic loading (micro- und macro cracks)</li> <li>Effect of notches</li> <li>Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter)</li> <li>Wear testing</li> <li>Non destructive testing application for overhaul of jet engines</li> </ul>
Literature	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



Course L0514: Metallic Materials for	Aircraft Applications
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.
	CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.
	Alpha+Beta alloys: Processing and microstructure, properties and applications.
	Beta alloys: Processing and microstructure, properties and applications
	Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements, thermomechanical treatment and resulting properties, long time stability at high temperatures
Literature	G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397
	C.T. Sims, W.C. Hagel: The Superalloys, John Wiley & Sons, New York, 1972, ISBN 0-471-79207-1

Course L0820: Aircraft Design I	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process
	<ol> <li>Introduction/process of aircraft design/various aircraft configurations</li> <li>Requirements and design objectives, main design parameter (u.a. payload-range-diagramme)</li> </ol>
	<ol> <li>Statistical methods in overall aircraft design/data base methods</li> </ol>
	<ol> <li>Principles of aircraft performance design (stability, V-n-diagramme)</li> </ol>
	5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics)
	6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry)
	7. Principles of engine design and integration
	8. Cruise design
	9. Design of runway and landing field length
	10. Cabin design (fuselage dimensioning, cabin interior, loading systems)
	11. System- and equipment aspects
	12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
	Recitation Section (large)
Hrs/wk	
CP	
Workload in Hours	
Examination Form	
Examination duration and scale	
Lecturer	Prof. Volker Gollnick
Language	
Cycle	WiSe
Content	Training in applying MatLab
	Application of design methods for civil aircraft concerning:
	Fuselage and Cabin sizing and design
	Calculation of aircraft masses
	Aerodynamic and geometric wing design
	TakeOff, landing cruise performance calculation
	Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design"
	D.P. Raymer: "Aircraft Design - A Conceptual Approach"
	J.P. Fielding: "Intorduction to Aircraft Design"
	Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0724: Microsystems Technology	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nancimprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVT LPCVD, PFCVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching will KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering plasma etching, NIE, Bosch process, XP2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origan microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LCA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensor thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor; plezoresistive, capacitiv and fabrication process; accelerometer; plezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process; accelerometer; plezoresistive, piezoelectric and capacitive; angular rate sensor; operating principle and fabrication process; accelerometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, largent resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, argani semiconductor gas sensor, Lambda probe, MOSFET gas sensor, principo electro</li></ul>
Literature	
	N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
	T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity Management	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	<ul> <li>Principles of productivity management</li> <li>Shop floor management and standardisation</li> <li>Takt analysis and design of manual operations</li> <li>Maintenance Principles</li> <li>Total Productive Maintenance (TPM)</li> <li>Optimisation of set-up operations</li> <li>Analysis of interlinked production systems</li> </ul>
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Ulf Pilz, Prof. Olaf Simanski
Language	DE
Cycle	SoSe
Content	Taking an engineering point of view, the lecture is structured as follows.
	<ul> <li>Introduction to the topic with selected examples</li> <li>Physiology - introduction and overview</li> <li>Regeneration of functions of the cardiovascular system</li> <li>Regeneration of the respiratory functions</li> <li>Closed loop control in anesthesia</li> <li>regeneration of kidney and liver functions</li> <li>regeneration of motorize function/rehabilitation engineering</li> <li>navigation systems and robotic in medicine</li> </ul> The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
Literature	Silbernagel/Depopoulos: Taschenatias der Physiologie, Thieme Verlag Stuttgart
	Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag
	M.C.K.Khoo:"Physiological Control System", IEEE Press, 2000



Course L0313: Renewable Energy	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul> Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008
	Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L0855: System Analysis in Air Transportation	
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	<ol> <li>Introduction to the Air Transport System</li> <li>System analysis methodologies</li> <li>Technology management</li> <li>Technical analysis methods</li> <li>Economical analysis methods</li> <li>Ecological analysis methods</li> <li>Ecological analysis methods</li> <li>Research on the future</li> <li>Synthesis, overall assessment, decision making</li> <li>Case studies - Technology Push</li> <li>Case studies - Scenario Pull</li> </ol>
Literature	Hand out

Course L1513: Technical Design	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Hausarbeit
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



SC	. "Product Development, Materials and Production"	Technisc
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications, a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	
	DRAWING	
	Barons Educational Series	
	ISBN-13: 978-0-7641-6182-7	
	Joseph Ungar, Rendering In Mixed Media - Techniques for Concept	
	Presentation for Designers and Illustrators	
	Watson-Guptil Publication a division of Billboard Publications Inc.,	
	New York 1985	
	AIRWORLD	
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
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	Frank Littek	
	Motorbuch Verlag 2003	
	Jetliner Cabins	
	Jennifer Coutts Clay	
	Cs books England 2006	
	BOEING Widebodies	
	Michael Haenggi motorbooks international USA 2003	
	form - Zeitschrift für Gestaltung, Verlag form GmbH,	
	Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim	
	(erscheint vierteljährlich, Verlag form GmbH)	
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	(erscheint monatlich)	
	CAR STYLING, Car Styling Publishing Co. 4-8-16-11F, Kitashinjuku, Shinjuku-ku, Tokio 160, Japan	
	Riasminjuku, Sminjuku-ku, Tokio Too, Japan (erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland Gm	ъH
	Auto & Design,	
	Corso Frabcia 161, 10139 Torino, Italia	
	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei	
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Monate , erhältlich am HBF Hamburg



AERO International,
Magazin für Zivilluftfahrt
(erscheint monatlich)
Aircraft interior international
Engl. magasin for Aircraft cabin interior
(erscheint 2 monatlich)
aerotec
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
	Dr. Rolf Janßen
Language	
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed. Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.
	Content: 1. Introduction
	Inhalt: 2. Raw materials
	3. Powder fabrication
	4. Powder processing
	5. Shape-forming processes
	6. Densification, sintering
	7. Glass and Cement technology
	8. Ceramic-metal joining techniques
Literature	W.D. Kingery, "Introduction to Ceramics", John Wiley & Sons, New York, 1975
	ASM Engineering Materials Handbook Vol.4 "Ceramics and Glasses", 1991
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung



Course L0949: Materials Testing	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	
	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
	Method for calculation and testing of reliability of dynamic machine systems  Modeling  System identification  Simulation  Processing of measurement data Damage accumulation  Test planning and execution
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 L1303: Reliability in Engineering Dynamics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 min
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0749: Reliability of Aircraft	Course L0749: Reliability of Aircraft Systems		
Тур	ture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	90 Minuten		
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>		
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>		



Courses				
Title		Тур	Hrs/wk	CP
Computer and communication technology		Lecture	2	2
Computer and communication technology		Recitation Section (small)	1	1
Model-Based Systems Engineering (MBSE		Problem-based Learning	3	3
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
	Previous knowledge in:			
	Systems Engineering			
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results		
Professional Competence				
Knowledge	Students are able to:			
	<ul> <li>describe the structure and operation of computer architectures</li> </ul>			
	explain the structure and operation of digital communication N			
	explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN)			
	<ul> <li>understand the approach of Model-Based Systems Engineering</li> </ul>	ng (MBSE) in the design of hardware and so	ftware-based cabin	systems
Skills	Students are able to:			
	understand, operate and maintain a Minicomputer			
	• build up a network communication and communicate with other	er network participants		
	connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network			
	model system functions by means of formal languages SysML/UML and generate software code from the models			
	execute software code on a minicomputer			
Personal Competence				
Social Competence	Students are able to:			
	elaborate partial results and merge with others to form a comp	lete solution		
Autonomy	Students are able to:			
	<ul> <li>organize and schedule their practical tasks</li> </ul>			
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	Aircraft Systems Engineering: Specialisation Aircraft Systems: E			
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation			
	Aircraft Systems Engineering: Specialisation Cabin Systems: C			
	International Management and Engineering: Specialisation II. A			
	Product Development, Materials and Production: Specialisation		У	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Specialisation Aircraft System	stems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementar			



Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Ralf God		
Language	DE		
Cycle	WiSe		
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electron		
	systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowaday		
	requires a basic understanding of cabin electronics and avionics.		
	The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles ar		
	applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:		
	History of computer and network technology		
	Layer model in computer technology		
	Computer architectures (PC, IPC, Embedded Systems)		
	BIOS, UEFI and operating system (OS)		
	Programming languages (machine code and high-level languages)		
	Applications and Application Programming Interfaces		
	External interfaces (serial, USB, Ethernet)		
	Layer model in network technology		
	Network topologies		
	Network components		
	Bus access procedures		
	Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)		
	Cabin electronics and cabin networks		
Literature	- Skript zur Vorlesung		
	- Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Boc		
	on Demand; 1. Auflage, 2003		
	- Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand;		
	Auflage, 2004		
	- Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessore		
	Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006		

Course L1558: Computer and comm	nunication technology in cabin electronics and avionics
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics.
	The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks:      History of computer and network technology      Layer model in computer technology      Computer architectures (PC, IPC, Embedded Systems)      BIOS, UEFI and operating system (OS)      Programming languages (machine code and high-level languages)      Applications and Application Programming Interfaces      External interfaces (serial, USB, Ethernet)      Layer model in network technology      Network topologies      Network components      Bus access procedures      Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN)      Cabin electronics and cabin networks
Literature	
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003</li> <li>Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004</li> <li>Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006</li> </ul>



Course L1551: Model-Based System	ns Engineering (MBSE) with SysML/UML
•	Problem-based Learning
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011



<b>urses</b> le newable Energy Projects in Emerged Marke				
Newable Energy Projects in Emerged Market		Тур	Hrs/wk	CP
ISWAUE ELETUX ETUECIS IL ETIELORO MARK	ets (L0014)	Project Seminar	1	1
dro Power Use (L0013)		Lecture	1	1
nd Turbine Plants (L0011)		Lecture	2	3
nd Energy Use - Focus Offshore (L0012)		Lecture	1	1
Module Responsible Dr.	. Joachim Gerth			
Admission Requirements No	one			
Recommended Previous Mo	odule: Technical Thermodynamics I,			
Knowledge Mc	odule: Technical Thermodynamics II,			
Мс	odule: Fundamentals of Fluid Mechanics			
Educational Objectives Aft	ter taking part successfully, students have reached the followin	g learning results		
Professional Competence	·	-		
	ending this module students can explain in detail knowledge	e of wind turbines with a particular for	cus of wind energy use in	offshore conditions and
cai	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of wate power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countrie outside Europe.			nentally the use of water
	rough active discussions of various topics within the semi eoretical background and are thus able to transfer what they have		e their understanding an	d the application of the
res im	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
	tudents can discuss scientific tasks subjet-specificly and multid	lisciplinary within a seminar.		
	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
147-11				
	dependent Study Time 110, Study Time in Lecture 70			
Credit points 6				
	ritten exam			
	hours written exam			
	vil Engineering: Specialisation Structural Engineering: Elective			
Curricula Civ	vil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
Civ	vil Engineering: Specialisation Coastal Engineering: Elective (	Compulsory		
En	nergy and Environmental Engineering: Specialisation Energy E	Engineering: Elective Compulsory		
Int	ernational Management and Engineering: Specialisation II. Re	enewable Energy: Elective Compulsor	y	
Int	ernational Management and Engineering: Specialisation II. Er	nergy and Environmental Engineering:	Elective Compulsory	
Pro	oduct Development, Materials and Production: Specialisation	Product Development: Elective Compu	Ilsory	
Pri	oduct Development, Materials and Production: Specialisation	Production: Elective Compulsory		
Pri	oduct Development, Materials and Production: Specialisation I	Materials: Elective Compulsory		
Re	enewable Energies: Core qualification: Compulsory			
Pri	ocess Engineering: Specialisation Environmental Process Eng	gineering: Elective Compulsory		
W	ater and Environmental Engineering: Specialisation Environme	ent: Compulsory		
	ater and Environmental Engineering: Specialisation Cities: Ele			



Course L0014, Benewable Energy F	Invianta in Emorged Marketa			
Course L0014: Renewable Energy P				
Тур	Project Seminar			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer				
Language	DE			
Cycle	SoSe			
Content	1. Introduction			
	<ul> <li>Development of renewable energies worldwide</li> </ul>			
	<ul> <li>Bevelophient of renewable energies wondwide</li> <li>History</li> </ul>			
	<ul> <li>Future markets</li> </ul>			
	<ul> <li>Special challenges in new markets - Overview</li> </ul>			
	2. Sample project wind farm Korea			
	Survey			
	Technical Description			
	<ul> <li>Project phases and characteristics</li> </ul>			
	3. Funding and financing instruments for EE projects in new markets			
	Overview funding opportunitie			
	Overview countries with feed-in laws			
	Major funding programs			
	4. CDM projects - why, how , examples			
	Overview CDM process			
	• Examples			
	• Exercise CDM			
	5. Rural electrification and hybrid systems - an important future market for EE			
	Rural Electrification - Introduction			
	Types of Elektrizifierungsprojekten			
	<ul> <li>The role of the EEInterpretation of hybrid systems</li> </ul>			
	<ul> <li>Project example: hybrid system Galapagos Islands</li> </ul>			
	6. Tendering process for EE projects - examples			
	South Africa			
	• Brazil			
	7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank			
	• Geothermal			
	Wind or CSP			
	Within the seminar, the various topics are actively discussed and applied to various cases of application.			
Literature	Folien der Vorlesung			

Course L0013: Hydro Power Use			
Тур	Lecture		
Hrs/wk	1		
CP			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Stephan Heimerl		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction, importance of water power in the national and global context</li> <li>Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies</li> <li>Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems</li> <li>Construction of hydroelectric power plants: description of the individual components and their technical system interaction</li> <li>Structural engineering components: representation of dams, weirs, dams, power houses, computer systems, etc.</li> <li>Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection</li> <li>Hydropower and the Environment</li> <li>Examples from practice</li> </ul>		
Literature	<ul> <li>Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage</li> <li>Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage</li> <li>Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage</li> <li>von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage</li> <li>Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006</li> </ul>		



Course L0011: Wind Turbine Plants		
Тур	re	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Rudolf Zellermann	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Historical development</li> <li>Wind: origins, geographic and temporal distribution, locations</li> <li>Power coefficient, rotor thrust</li> <li>Aerodynamics of the rotor</li> <li>Operating performance</li> <li>Power limitation, partial load, pitch and stall control</li> <li>Plant selection, yield prediction, economy</li> <li>Excursion</li> </ul>	
Literature	Gasch, R., windkraitaniagen, 4. Auliage, reubner-venag, 2005	

Course L0012: Wind Energy Use - F	ocus Offshore
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering</li> <li>Physical fundamentals for utilization of wind energy</li> <li>Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships</li> <li>Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures of an offshore wind farm, Inner Park cabling, offshore substation, grid connection</li> <li>Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics</li> <li>Development and planning of offshore wind farms</li> <li>Operation and optimization of offshore wind farms</li> <li>Day excursion</li> </ul>
Literature	<ul> <li>Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage</li> <li>Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage</li> <li>Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage</li> <li>Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage</li> </ul>



Courses				
ïtle		Тур	Hrs/wk	СР
Supply Chain Management (L1218)		Problem-based Learning	3	4
alue-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	None			
Recommended Previous	no			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence		<b>6</b>	- Maria and a late to Maria Maria	
Knowledge	Current developments in international business activities such	as outsourcing, offshoring, internationaliza	ation and globalizatio	in and emerging mar
	illustrated by examples from practice.	an management and use in practice		
	<ul> <li>Theoretical Approaches and methods in logistics and supply c</li> <li>to identify fields of decision in SCM.</li> </ul>	fair management and use in practice.		
	<ul> <li>reasons for the formation of networks based on various theor</li> </ul>	es from institutional economics (transaction	n cost theory princip	al-agent theory prop
	right theory) and the resource-based view.		n oost theory, principt	a agent alcoly, prope
	<ul> <li>Selected approaches to explain the development of networks.</li> </ul>			
	<ul> <li>to illustrate phases of network formation.</li> </ul>			
	• to understand the functional mechanisms of inter-organization	al and international network relationships.		
	• to explain and categorize relationships within networks.			
	• to categorize sourcing concepts and explain motives/ barriers	or advantages and disadvantages.		
	• advantages and disadvantages of offshoring and outsourcing	and to illustrate the distinction between the	two terms .	
	• to state criteria/ factors/ parameters that influence production lo	cation decisions at the global level (total n	etwork costs).	
	• to explain methods for location finding/evaluation.			
	<ul> <li>to interpret phenotypes of production networks.</li> </ul>			
	• recognize relationships between R & D and production and their locations and to describe coherent models.			
	• to solve sub-problems with the configuration of logistics networks (distribution and spare parts networks ) by the use of appropriate approaches.			
	to categorise special waste logistics including their duties & ob-	jectives and to state and describe practical	examples of good ne	etworking.
Skills	• to asses trends and challenges in national and international si	only chains and logistics networks and the	air consequences for (	companies
Okino -	<ul> <li>to evaluate, anaylse and systematise networks and network re</li> </ul>			inpanico.
	<ul> <li>to anaylse partners and their suitability for co-operation in collaborations and cooperative relations.</li> </ul>			
	• to select sourcing concepts for specific products / product		I as advantages and	d disadvantages of e
	approach.		-	-
	• to evaluate location decisions for production and R & D based	on concepts.		
	• to recognize relationships between R & D and production a	s well as their locations and to evaluate	the suitability of spe	cific models for diffe
	situations.			
	• to transfer the analyzed concepts to international practices.			
	$\ensuremath{\cdot}$ to analyse and evaluate the product development processes.			
	• to anallse concepts of Information and communication manag	ement in logistics.		
	• to design subcontracting, procurement, production and dispos	al as well as R & D networks to shape,		
	• to plan reorganise efficient and flow-oriented enterprise networks.			
	• to adopt methods of complexity management and risk manage	ment in logistics.		
Personal Competence				
Social Competence	• to evaluate intercultural and international relationships based	on discussed case studies.		
	advance planning and design of network formation and their of		e lecture.	
	definition of procurement strategies for individual parts using the second strategies for second strategies for individual parts using the second strategies for second stra			
	design of the procurement network (external/internal/modules			as well as on the find
	of the case studies.			
	• to make decision of location for production taking into acco	unt global contexts, evaluation methods	and buying/selling m	narkets, which were
	discussed in the case studies and their dependence on R & D.			
	Decision on R & D locations based on the insights gained from	case studies / practical examples and the	selection of an appro	priate model.
A		dependently, on the sylbight of Cymply C	hain Managament a	
Autonomy	After completing the module students are capable to work in	dependently on the subject of Supply C	nain Management a	nd transfer the acqu
	knowledge to new problems.			
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	International Management and Engineering: Specialisation I. El	ectives Management: Elective Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Specialisation Production			
	Product Development, Materials and Production: Specialisation		ry	
	Product Development, Materials and Production: Specialisation		-	



urse L1218: Supply Chain Manag	ement
Тур	Problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	SoSe
Content	<ul> <li>Transmission of a profound understanding in logistics and supply chain management</li> <li>Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts t business cases</li> <li>Identification of trends and challenges in national and international supply chains</li> <li>Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push c pull-based strategies, efficiency vs. responsiveness)</li> <li>Elaboration of approaches and goals in the field of resource planning and supplier management</li> <li>Identification and analyzes of concepts in logistics management</li> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul>
Literature	<ul> <li>Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin.</li> <li>Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3<sup>rd</sup> edition, Upper Saddle River, NJ, Pearson/Prentic Hall.</li> <li>Heizer, J. und Render, B. (2006): Principles of Operations Management. Prentice Hall.</li> <li>Fisher, M. (1997): What is the right supply chain for your product?, Harvard Business Review, Vol. 75, No. pp., S. 105-116.</li> <li>Kuhn, A. und Hellingrath, B. (2002): Supply Chain Management: optimierte Zusammenarbeit in der Wertschöpfungskette, Berlin [u.a.], Springer.</li> <li>Larson, P., Poist, R., Halldórsson, Á. (2007): PERSPECTIVES ON LOGISTICS VS. SCM: A SURVEY OF SCM PROFESSIONALS, in: Journal of Busines Logistics, Vol. 28, No. 1, 2007, S. 3ff.</li> <li>Kummer, S., Hrsg. (2006): Grundzüge der Beschaffung, Produktion und Logistik, München: Pearson Studium.</li> <li>Porter, M. (1986): Changing Patterns of International Competition, California Management Review, Vol. 28, No. 2, pp. 9-40.</li> <li>Simchi-Levi, D., Kaminsky, P. und Simchi-Levi, E. (2008): Designing and managing the supply chain: concepts, strategies and case studies, 3. ec McGraw-Hill.</li> <li>Supply Chain Council (2010): Supply Chain Operations Reference (SCOR) model: Overview – Version 10.0, [online] :: http://supplychain.org/f/Web Sco Overview.pdf.</li> <li>Swink, M., Melnyk, S. A., Cooper, M. B., Hartley, J. L. (2011): Managing Operations – Across the Supply Chain. McGraw-Hill/Irwin.</li> </ul>



Course L1190: Value-Adding Netwo	rks
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Blecker
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>



Module M0630: Robotics a	nd Navigation in Medicine			
Courses				
Title		Тур	Hrs/wk	CP
Robotics and Navigation in Medicine (L033		Lecture	2	3
Robotics and Navigation in Medicine (L03		Project Seminar	2	2
Robotics and Navigation in Medicine (L03		Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous	<ul> <li>principles of math (algebra, analysis/calculus)</li> </ul>			
Knowledge	<ul> <li>principles of programming, e.g., in Java or C++</li> </ul>			
	<ul> <li>solid R or Matlab skills</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking system	ns in clinical contexts and illustrate systems and	d their components in	details. Systems can b
	evaluated with respect to collision detection and safety a	nd regulations. Students can assess typical syste	ms regarding design	and limitations.
Skills	The students are able to design and evaluate navigation	systems and robotic systems for medical applicat	ions.	
Personal Competence				
Social Competence	The students discuss the results of other groups, provide	helpful feedback and can incoorporate feedback	into their work.	
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.		nanner.	
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	Computer Science: Specialisation Intelligence Engineerin	ag: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Medical Technolog			
Guineula	Computational Science and Engineering: Specialisation		nulsory	
	International Management and Engineering: Specialisation			
	Mechatronics: Specialisation Intelligent Systems and Rob			
	Biomedical Engineering: Specialisation Artificial Organs		/	
	Biomedical Engineering: Specialisation Implants and End	• • •		
	Biomedical Engineering: Specialisation Medical Technol-			
	Biomedical Engineering: Specialisation Medical Federation			
	Product Development, Materials and Production: Special		rv	
	Product Development, Materials and Production: Special		.,	
	Product Development, Materials and Production: Special			
	Theoretical Mechanical Engineering: Technical Complen			
	Theoretical Mechanical Engineering: Specialisation Bio-			
		g, Liouro compañory		

Course L0335: Robotics and Navigation in Medicine	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	- kinematics
	- calibration
	- tracking systems
	- navigation and image guidance
	- motion compensation
	The seminar extends and complements the contents of the lecture with respect to recent research results.
Literature	Spong et al.: Robot Modeling and Control, 2005
	Troccaz: Medical Robotics, 2012
	Further literature will be given in the lecture.

Cycle

SoSe Content See interlocking course Literature See interlocking course



Course L0338: Robotics and Naviga	tion in Medicine	
Тур	Project Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	
Course L0336: Robotics and Naviga	ation in Medicine	
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	EN	



Module M0764: Aircraft Sys	stems II			
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Systems II (L0736)		Lecture	3	4
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge	mathematics			
	mechanics			
	thermo dynamics			
	electronics			
	<ul> <li>fluid technology</li> </ul>			
	control technology			
	control toomology			
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students are able to			
	<ul> <li>describe the structure of primary flight control system</li> </ul>	me as well as actuation, suissis, fuel, an	d landing goor outo	ma in general along wit
		ns as well as actuation-, avionic-, luel- and	a landing gear-syste	ms in general along will
	<ul><li>corresponding properties and applications.</li><li>explain different configurations and designs and their</li></ul>	origing		
	<ul> <li>explain different configurations and designs and their</li> <li>explain atmospheric conditions for icing such as the full</li> </ul>			
	• explain autospheric conditions for long such as the ic	inclionality of anti-ice systems		
Skills	Students are able to			
	<ul> <li>size primary flight control actuation systems</li> </ul>			
	perform a controller design process for the flight control	ol actuators		
	<ul> <li>design high-lift kinematics</li> </ul>			
	<ul> <li>design and analyse landing gear systems</li> </ul>			
	design anti-ice systems			
Personal Competence				
Social Competence	Students are able to:			
Cociai Compelence				
	Develop joint solutions in mixed teams			
Autonomy	Students are able to:			
	<ul> <li>derive requirements and perform appropriate yet sin</li> </ul>	plified design processes for aircraft systems	s from complex issue	s and circumstances in a
	self-reliant manner			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory	,		
Curricula	International Management and Engineering: Specialisation II	Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisati	on Product Development: Elective Compulso	ory	
	Product Development, Materials and Production: Specialisati	on Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisati	on Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complement	ary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft S	systems Engineering: Elective Compulsory		



ourse L0736: Aircraft Systems II		
Тур	Lecture	
Hrs/wk		
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechani actuation systems)</li> <li>Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible an irreversible flight control systems; servo actuation systems)</li> <li>Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems)</li> <li>Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>	
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>Curry: Aircraft Landing Gear Design: Principles and Practices</li> </ul>	

Course L0740: Aircraft Systems II	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Iodule M0811: Medical Ima	iging Systems			
Courses				
ïtle		Тур	Hrs/wk	CP
Medical Imaging Systems (L0819)		Lecture	4	6
Module Responsible	Dr. Michael Grass			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge				
	Students can:			
	<ul> <li>Describe the system configuration and components or</li> </ul>	the main clinical imaging systems:		
	<ul> <li>Explain how the system components and the overall s</li> </ul>		n.	
	<ul> <li>Explain and apply the physical processes that make in</li> </ul>			
	<ul> <li>Name and describe the physical effects required to get</li> </ul>			
	<ul> <li>Explain how spatial and temporal resolution can be in</li> </ul>		images generated;	
	<ul> <li>Explain which image reconstruction methods are used</li> </ul>	I to generate images;		
	Describe and explain the main clinical uses of the different sy	stems.		
Skills	Students are able to:			
	Explain the physical processes of images and assign			d;
	<ul> <li>Calculate the parameters of imaging systems in Determine the influence of this</li> </ul>			
	Determine the influence of different system con			
	<ul> <li>Explain the importance of different imaging system</li> </ul>	terns for a number of chinical applicat	ions,	
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence	none			
Autonomy	Students can:			
		Linnation		
	Understand which physical effects are used in medica     Decide independently for which elipical issue a measurement			
	<ul> <li>Decide independently for which clinical issue a measure</li> </ul>	inng system can be used.		
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	Electrical Engineering: Specialisation Medical Technology: E	lective Compulsory		
	Biomedical Engineering: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisati	on Product Development: Elective Co	mpulsory	
	Product Development, Materials and Production: Specialisati		-	
	Product Development, Materials and Production: Specialisati	on Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complement	ary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Bio- and	Medical Technology: Elective Compu	ilsory	
ourse L0819: Medical Imaging Sys	tems			
Тур	Lecture			
Hrs/wk	4			

Тур	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book:
	1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press
	Secondary books:
	- A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003.
	- W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002.
	- H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995.
	- O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.



Module M1143: Mechanica	Design Methodology			
Courses				
Title		Тур	Hrs/wk	CP
Mechanical Design Methodology (L1523)		Lecture	3	4
Mechanical Design Methodology (L1524)		Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Science-based working on product design considering targeted	application of specific product design tec	hniques	
Skills	Creative handling of processes used for scientific preparation and formulation of complex product design problems / Application of various product design techniques following theoretical aspects.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	International Management and Engineering: Specialisation II. Pr	oduct Development and Production: Elec	tive Compulsory	
Curricula	Mechatronics: Specialisation System Design: Elective Compulso	ry		
	Biomedical Engineering: Specialisation Artificial Organs and Re	generative Medicine: Elective Compulsor	ту	
	Biomedical Engineering: Specialisation Implants and Endoprost	neses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and	Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Busin	ess Administration: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulse	ory	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Dev	velopment and Production: Elective Comp	oulsory	
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory		

Course L1523: Mechanical Design	Aethodology	
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Josef Schlattmann	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>	
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>	



Course L1524: Mechanical Design M	lethodology
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Josef Schlattmann
Language	DE
Cycle	SoSe
Content	<ul> <li>Systematic reflection and analysis of the mechanical design process</li> <li>Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels)</li> <li>Creativity (basics, methods, practical application in mechatronics)</li> <li>Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ)</li> <li>Evaluation and selection (technical-economical evaluation, preference matrix)</li> <li>Value analysis, cost-benefit analysis</li> <li>Low-noise design of technical products</li> <li>Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication)</li> <li>Aesthetic product design (industrial design, colouring, specific examples / exercises)</li> </ul>
Literature	<ul> <li>Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7 Auflage, Springer Verlag, Berlin 2007</li> <li>VDI-Richtlinien: 2206; 2221ff</li> </ul>



Module M1145: Automation	and Simulation			
Courses				
Title		Тур	Hrs/wk	CP
Automation and Simulation (L1525)		Lecture	3	3
Automation and Simulation (L1527)		Recitation Section (large)	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	BSc Mechanical Engineering or similar			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rning results		
Professional Competence				
Knowledge	Students can describe the structure an the function of process corprogrammable logic computers .	emputers, the corresponding compo	onents, the data tran	sfer via bus systems a
	They can describe the basich principle of a numeric simulation and the	e corresponding parameters.		
	Thy can explain the usual method to simulate the dynamic behaviour	of three-phase machines.		
Skills	Students can describe and design simple controllers using establishe	d methodes.		
	They are able to assess the basic characterisitos of a given automatio	n system and to evaluate, if it is adec	quate for a given plant	
	They can modell and simulate technical systems with respect to their or	dynamical behaviour and can use Ma	atlab/Simulink for the	simulation.
	They are able to applay established methods for the caclulation of the	e dynamical behaviour of three-phase	e machines.	
Personal Competence				
Social Competence	Teamwork in small teams.			
Autonomy	Students are able to identify the need of methocic analysises in the	field of automation systems, to do th	nese analysisis in an	adequate manner und
	evaluate the results critically.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde			
Assignment for the Following	Energy Systems: Core qualification: Elective Compulsory			
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective	Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective			
	International Management and Engineering: Specialisation II. Energy		ective Compulsory	
	International Management and Engineering: Specialisation II. Aviation		( <b>)</b>	
	International Management and Engineering: Specialisation II. Product		ive Compulsorv	
	Mechatronics: Specialisation System Design: Elective Compulsory	-p		
	Mechatronics: Specialisation Intelligent Systems and Robotics: Electiv	ve Compulsory		
	Product Development, Materials and Production: Specialisation Produ		ry	
	Product Development, Materials and Production: Specialisation Produ			
	Product Development, Materials and Production: Specialisation Mater			



Course L1525: Automation and Sim			
Тур	Lecture		
Hrs/wk	3		
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	NN		
Language	DE		
Cycle	SoSe		
Content	Structure of automation systsems		
	Aufbau von Automationseinrichtungen		
	Structure and function of process computers and corresponding componentes		
	Data transfer via bus systems		
	Programmable Logic Computers		
	Methods to describe logic sequences		
	Prionciples of the modelling and the simulation of continous technical systems		
	Practical work with an established simulation program (Matlab/Simulink)		
	Simulation of the dynamic behaviour of a three-phase maschine, simulation of a mixed continous/discrete system on base of tansistion flow diagrams.		
Literature	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag		
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag		
	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag		
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren		

ourse L1527: Automation and Simulation	
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M1156: Systems E	naineerina			
Courses				
Title		Тур	Hrs/wk	CP
Systems Engineering (L1547)		Lecture	3	4
Systems Engineering (L1548)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
	Provious knowledge in:			
	Previous knowledge in: • Aircraft Cabin Systems			
	· And all Gabin Systems			
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	Students are able to:			
	• understand systems engineering process models, methods a	nd tools for the development of complex Sys	stems	
	describe innovation processes and the need for technology N	lanagement		
	• explain the aircraft development process and the process of t	ype certification for aircraft		
	• explain the system development process, including requirem	ents for systems reliability		
	· identify environmental conditions and test procedures for airb	orne Equipment		
	• value the methodology of requirements-based engineering (I	RBE) and model-based requirements engine	eering (MBRE)	
Skille	Students are able to:			
Skills				
	plan the process for the development of complex Systems			
	<ul> <li>organize the development phases and development Tasks</li> <li>assign required business activities and technical Tasks</li> </ul>			
	apply systems engineering methods and tools			
	· apply systems engineering methods and tools			
Personal Competence				
Social Competence	Students are able to:			
	• understand their responsibilities within a development team a	and integrate themselves with their role in the	e overall process	
A t_	Studente ere oble te:			
Autonomy	Students are able to:	distributed tasks		
	interact and communicate in a development team which has	LISTIDUEU LASKS		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II.	Aviation Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II.	Product Development and Production: Elect	ive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compul	sory		
	Mechatronics: Specialisation Intelligent Systems and Robotics	: Elective Compulsory		
	Product Development, Materials and Production: Specialisatio			
	Product Development, Materials and Production: Specialisatio	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisatio			
	Theoretical Mechanical Engineering: Technical Complementa			



Course L1547: Systems Engineering	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems
	using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved.
	Regulations, guidelines and certification issues will be known.
	Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools
	and methods for systems engineering:
	Innovation processes
	IP-protection
	Technology management
	Systems engineering
	Aircraft program
	Certification issues
	Systems development
	Safety objectives and fault tolerance
	Environmental and operating conditions
	Tools for systems engineering
	Requirements-based engineering (RBE)
	Model-based requirements engineering (MBRE)
Literature	- Skript zur Vorlesung
	- diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE)
	- Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010
	- NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007
	- Hinsch, M.: Industrielles Luftfahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010
	- De Florio, P.: Airworthiness: An Introduction to Aircraft Certification. Elsevier Ltd., 2010
	- Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008

Course L1548: Systems Engineerin	Course L1548: Systems Engineering	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Ralf God	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1161: Turbomach	hinery			
	linery			
Courses				
Title		Тур	Hrs/wk	CP
Turbomachines (L1562)		Lecture	3	4
Turbomachines (L1563)		Recitation Section (large)	1	2
Module Responsible	Prof. Franz Joos			
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	The students can			
	<ul> <li>distinguish the physical phenomena of conversion of energy</li> </ul>			
	<ul> <li>understand the different mathematic modelling of turbomach</li> </ul>			
	<ul> <li>calculate and evaluate turbomachinery.</li> </ul>	incry,		
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
,				
	<ul> <li>discuss in small groups and develop an approach.</li> </ul>			
Autonomy	The students are able to			
	develop a complex problem self-consistent,			
	analyse the results in a critical way,			
	<ul> <li>have an qualified exchange with other students.</li> </ul>			
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	Energy Systems: Specialisation Energy Systems: Compulsory			
Curricula	Energy Systems: Specialisation Marine Engineering: Elective Comp	ulsory		
	Product Development, Materials and Production: Specialisation Pro	duct Development: Elective Compulso	ry	
	Product Development, Materials and Production: Specialisation Pro	duction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Mat	erials: Elective Compulsory		

Course L1562: Turbomachines	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Franz Joos
Language	DE
Cycle	SoSe
Content	Topics to be covered will include:
1 Haveton	<ul> <li>Application cases of turbomachinery</li> <li>Fundamentals of thermodynamics and fluid mechanics</li> <li>Design fundamentals of turbomachinery</li> <li>Introduction to the theory of turbine stage</li> <li>Design and operation of the turbocompressor</li> <li>Design and operation of the steam turbine</li> <li>Design and operation of the gas turbine</li> <li>Physical limits of the turbomachines</li> </ul>
Literature	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>



Course L1563: Turbomachines	Course L1563: Turbomachines	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1170: Phenomen	a and Methods in Materials Science			
Courses				
Title		Тур	Hrs/wk	CP
Experimental Methods for the Characteriz	ation of Materials (L1580)	Lecture	2	3
Phase equilibria and transformations (L15	79)	Lecture	2	3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science (I and II)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advance	ed materials along with their applica	ations in technology, in par	ticular metallic, ceramic
	polymeric, semiconductor, modern composite materials (biomat	erials) and nanomaterials.		
Skille	The students will be able to select material configurations ac	cording to the technical needs and	if pacescany to design po	w materials considering
Skiils	architectural principles from the micro- to the macroscale. The			
	select optimum materials combinations depending on the techn	•	II modern materials science	, which enables them to
	select optimum materials combinations depending on the techn	ical applications.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to o	levelop ideas further.		
Autonomy	The students are able to			
	<ul> <li>assess their own strengths and weaknesses.</li> </ul>			
	<ul> <li>define tasks independently.</li> </ul>			
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	International Management and Engineering: Specialisation II. P	roduct Development and Production:	Elective Compulsory	
Curricula	Materials Science: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation	Product Development: Elective Comp	pulsory	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Materials: Compulsory		
	Theoretical Mechanical Engineering: Specialisation Materials S	cience: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Materials S	cience: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory		

Course L1580: Experimental Methods for the Characterization of Materials		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Patrick Huber	
Language	DE/EN	
Cycle	SoSe	
Content	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>	
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 L1579: Phase equilibria and	transformations
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.



Module M1226: Mechanica	Properties			
	Flopenies			
Courses				
Title		Тур	Hrs/wk	CP
Mechanical Behaviour of Brittle Materials (	L1661)	Lecture	2	3
Dislocation Theory of Plasticity (L1662)		Lecture	2	3
Module Responsible	Dr. Erica Lilleodden			
Admission Requirements	None			
Recommended Previous	Basics in Materials Science I/II			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students can explain basic principles of crys	stallography, statics (free body diagrams, tractions)	and thermodynamics (ene	rgy minimization, ener
	barriers, entropy)			
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Personal Competence				
Social Competence	Students can provide appropriate feedback and	d handle feedback on their own performance construc	ctively.	
Autonomy	Students are able to			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific to	erms and to define further work steps on this basis gui	ided by teachers.	
	- work independently based on lectures and no	otes to solve problems, and to ask for help or clarificati	ons when needed	
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Materials Science: Core qualification: Compute	sory		
Curricula	Mechanical Engineering and Management: Sp	ecialisation Materials: Elective Compulsory		
	Product Development, Materials and Productio	n: Specialisation Product Development: Elective Com	pulsory	
	Product Development, Materials and Productio	n: Specialisation Production: Elective Compulsory		
	Product Development, Materials and Productio	n: Specialisation Materials: Compulsory		



Course L1661: Mechanical Behavio	ur of Brittle Materials
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider
Language	DE/EN
Cycle	SoSe
Content	Theoretical Strength
	Of a perfect crystalline material, theoretical critical shear stress
	Real strength of brittle materials
	Energy release reate, stress intensity factor, fracture criterion
	Scattering of strength of brittle materials
	Defect distribution, strength distribution, Weibull distribution
	Heterogeneous materials I
	Internal stresses, micro cracks, weight function,
	Heterogeneous materials II
	Toughening mechanisms: crack bridging, fibres
	Heterogeneous materials III
	Toughening mechanisms. Process zone
	Testing methods to determine the fracture toughness of brittle materials
	R-curve, stable/unstable crack growth, fractography
	Thermal shock
	Subcritical crack growth)
	v-K-curve, life time prediction
	Kriechen
	Mechanical properties of biological materials
	Examples of use for a mechanically reliable design of ceramic components
Literature	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993
	D. Munz, T. Fett, Ceramics, Springer, 2001
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992

Course L1662: Dislocation Theory of	of Plasticity
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
Content	This class will cover the principles of dislocation theory from a physical metallurgy perspective, providing a fundamental understanding of the relations between the strength and of crystalline solids and distributions of defects.
	We will review the concept of dislocations, defining terminology used, and providing an overview of important concepts (e.g. linear elasticity, stress-strain relations, and stress transformations) for theory development. We will develop the theory of dislocation plasticity through derived stress-strain fields, associated self-energies, and the induced forces on dislocations due to internal and externally applied stresses. Dislocation structure will be discussed, including core models, stacking faults, and dislocation arrays (including grain boundary descriptions). Mechanisms of dislocation multiplication and strengthening will be covered along with general principles of creep and strain rate sensitivity. Final topics will include non-FCC dislocations, emphasizing the differences in structure and corresponding implications on dislocation mobility and macroscopic mechanical behavior; and dislocations in finite volumes.
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen



Module M0840: Optimal and	J Robust Control			
Courses				
Title		Тур	Hrs/wk	CP
Optimal and Robust Control (L0658)		Lecture	2	3
Optimal and Robust Control (L0659)		Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous				
Knowledge	<ul> <li>Classical control (frequency response, root locus)</li> <li>State space methods</li> </ul>			
	Linear algebra, singular value decomposition			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	<ul> <li>Students can explain the significance of the matrix Riccati</li> </ul>	equation for the solution of LO problems	e	
	<ul> <li>They can explain the duality between optimal state feedba</li> </ul>			
	<ul> <li>They can explain how the H2 and H-infinity norms are use</li> </ul>		constraints	
	<ul> <li>They can explain how an LQG design problem can be for</li> </ul>			
	<ul> <li>They can explain how model uncertainty can be represer</li> </ul>			
	They can explain how - based on the small gain theorem			r an uncertain plant.
	They understand how analysis and synthesis conditions of			
Skills	<ul> <li>Students are capable of designing and tuning LQG contro</li> </ul>	llers for multivariable plant models.		
	They are capable of representing a H2 or H-infinity design	gn problem in the form of a generalized	plant, and of using sta	andard software tools
	solving it.			
	They are capable of translating time and frequency dom	ain specifications for control loops into	constraints on closed-lo	oop sensitivity functio
	and of carrying out a mixed-sensitivity design.			
	They are capable of constructing an LFT uncertainty mode	el for an uncertain system, and of design	ing a mixed-objective ro	obust controller.
	They are capable of formulating analysis and synthesis	conditions as linear matrix inequalitie	s (LMI), and of using s	standard LMI-solvers
	solving them.			
	<ul> <li>They can carry out all of the above using standard softwar</li> </ul>	e tools (Matlab robust control toolbox).		
Personal Competence				
Social Competence	Students can work in small groups on specific problems to arrive	at joint solutions.		
Autonomy	Students are able to find required information in sources provided		mentation) and use it to	solve given problems
hatohomy				s contro girton problome
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Computer Science: Specialisation Intelligence Engineering: Elec	tive Compulsory		
Curricula	Electrical Engineering: Specialisation Control and Power System	s: Elective Compulsory		
	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Ele			
	Computational Science and Engineering: Specialisation Systems		mpulsory	
	Mechatronics: Specialisation Intelligent Systems and Robotics: E			
	Mechatronics: Specialisation System Design: Elective Compulsor			
	Biomedical Engineering: Specialisation Artificial Organs and Reg		У	
	Biomedical Engineering: Specialisation Implants and Endoprosth			
	Biomedical Engineering: Specialisation Medical Technology and			
	Biomedical Engineering: Specialisation Management and Busine			
	Product Development, Materials and Production: Specialisation F		уу	
	Product Development, Materials and Production: Specialisation F Product Development, Materials and Production: Specialisation N			
	Theoretical Mechanical Engineering: Technical Complementary			
	Theoretical Mechanical Engineering: Core qualification: Elective	Compulsory		



Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	<ul> <li>Optimal regulator problem with finite time horizon, Riccati differential equation</li> <li>Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system</li> <li>Kalman's identity, phase margin of LQR controllers, spectral factorization</li> <li>Optimal state estimation, Kalman filter, LQG control</li> <li>Generalized plant, review of LQG control</li> <li>Signal and system norms, computing H2 and H∞ norms</li> <li>Singular value plots, input and output directions</li> <li>Mixed sensitivity design, H∞ loop shaping, choice of weighting filters</li> <li>Case study: design example flight control</li> <li>Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region)</li> <li>Controller synthesis by solving LMI problems, multi-objective design</li> <li>Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty</li> </ul>
Literature	<ul> <li>Werner, H., Lecture Notes: "Optimale und Robuste Regelung"</li> <li>Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994</li> <li>Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996</li> <li>Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988</li> <li>Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998</li> </ul>

Course L0659: Optimal and Robust	Course L0659: Optimal and Robust Control	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1343: Fibre-polyn	ner-composites			
Courses				
Title		Тур	Hrs/wk	CP
Structure and properties of fibre-polymer-	composites (L1894)	Lecture	2	3
Design with fibre-polymer-composites (L1		Lecture	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous	Basics: chemistry / physics / materials science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results		
Professional Competence				
Knowledge	Students can use the knowledge of fiber-reinforced co	omposites (FRP) and its constituents to	o play (fiber / matrix) an	d define the necessary
	testing and analysis.			
	They can evalue the complex veletionships at at use an	anatty relationship and		
	They can explain the complex relationships structure-pr	operty relationship and		
	the interactions of chemical structure of the polymers,	their processing with the different fiber	types, including to expla	in neighboring contexts
	(e.g. sustainability, environmental protection).			
Skills	Students are capable of			
	- using standardized calculation methods in a given	contaxt to machanical proportion (ma	dulue etropath) to color	ulate and evaluate the
	different materials.	context to mechanical properties (no	duius, strengtri) to calci	
	unerent materials.			
	- Approximate sizing using the network theory of the str	uctural elements implement and evalua	te.	
	- For mechanical recycling problems selecting appropria	te solutions and sizing example Stiffne	es corrosion resistance	
Personal Competence			33, 00103101110313141100.	
Social Competence	Students can,			
	- arrive at work results in groups and document them.			
	- provide appropriate feedback and handle feedback on	their own performance constructively.		
Autonomy	Students are able to,	····· ···· ··· ··· ··· ··· ··· ··· ···		
,				
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific terms an	d to define further work steps on this ba	asis guided by teachers.	
<b></b>	- assess possible consequences of their professional ad	ctivity.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
• •	Energy Systems: Core qualification: Elective Compulsory			
Gurricula	Aircraft Systems Engineering: Specialisation Cabin Systems		Elective Compulsory	
	International Management and Engineering: Specialisation Materials Science: Specialisation Engineering Materials: El-			
	Materials Science. Specialisation Engineering Materials. En Mechanical Engineering and Management: Core qualification			
	Product Development, Materials and Production: Specialisa		oulsory	
	Product Development, Materials and Production: Specialisa		,	
	Product Development, Materials and Production: Specialisa			
	Renewable Energies: Specialisation Bioenergy Systems: E			
	Renewable Energies: Specialisation Solar Energy Systems	: Elective Compulsory		
	Renewable Energies: Specialisation Wind Energy Systems	: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Materia	als Science: Elective Compulsory		



Course L1894: Structure and properties of fibre-polymer-composites		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	SoSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction	
	- Development of composite materials	
	- Mechanical and physical properties	
	- Mechanics of Composite Materials	
	- Laminate theory	
	- Test methods	
	- Non destructive testing	
	- Failure mechanisms	
	- Theoretical models for the prediction of properties	
	- Application	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press	
Literature		
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press	
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L1893: Design with fibre-polymer-composites		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	SoSe	
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques;	
	Compression Loading; Examples	
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Module M1344: Processing	of fibre-polymer-composites			
Courses				
Title		Тур	Hrs/wk	CP
Processing of fibre-polymer-composites (	L1895)	Lecture	2	3
From Molecule to Composites Part (L1516	6)	Problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous	Structure and Properties of Polymers			
Knowledge	Structure and Properties of Composites			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technic	cal details of the manufacturing processes composites	and illustrate respectiv	e relationships. They are
	capable of describing and communicating relevan	t problems and questions using appropriate technical	language. They can ex	plain the typical process
	of solving practical problems and present related re	esults.		
Skills	The students can transfer their fundamental know	rledge on civil engineering to the process of solving	practical problems. The	av identify and overcome
<i>China</i>		s in the context of civil engineering. Students are able		
	solutions for non-standardized problems.	······································	· · · · · · · · · · · · · · · · · · ·	,
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-	subject groups in order to independently derive solu	utions to given probler	ms in the context of civi
	engineering. They are able to effectively present a	nd explain their results alone or in groups in front of a	qualified audience. St	udents have the ability to
	develop alternative approaches to an engineering	problem independently or in groups and discuss adva	ntages as well as draw	backs.
Autonomy	Students are capable of independently solving me	chanical engineering problems using provided literatu	ire. They are able to fill	gaps in as well as exten
	their knowledge using the literature and other so	purces provided by the supervisor. Furthermore, they	can meaningfully exte	end given problems and
	pragmatically solve them by means of correspondi	ng solutions and concepts.		
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Materials Science: Specialisation Engineering Mat	erials: Elective Compulsory		
Curricula	Mechanical Engineering and Management: Specia	alisation Materials: Elective Compulsory		
	Product Development, Materials and Production: S	pecialisation Product Development: Elective Compuls	ory	
	Product Development, Materials and Production: S	pecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	pecialisation Materials: Elective Compulsory		

Course L1895: Processing of fibre-polymer-composites	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall

Course L1516: From Molecule to Co	mposites Part
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task
	technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective
	documents (electronically and in conversation).
	The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made
	handlebar with approved quality.
	In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established
	manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of
	the final report created (compilation of the results for the "customers").
	After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous
	improvement.
Literature	Customer Request ("Handout")



Module M0563: Robotics				
Courses				
Title		Тур	Hrs/wk	CP
Robotics: Modelling and Control (L0168)		Lecture	3	3
Robotics: Modelling and Control (L1305)		Recitation Section (small)	2	3
Module Responsible	Prof. Uwe Weltin			-
Admission Requirements	None			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Broad knowledge of mechanics			
	Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties of robots an	d solution approaches for multiple proble	ms in robotics.	
Skills	Students are able to derive and solve equations of motion for varie	ous manipulators.		
	Students can generate trajectories in various coordinate systems.			
	Students can design linear and partially nonlinear controllers for r	obotic manipulators.		
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 in	dependently.		
	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 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Computer Science: Specialisation Intelligence Engineering: Elect	ve Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Ele	ctive Compulsory		
	Computational Science and Engineering: Specialisation Systems	Engineering and Robotics: Elective Com	pulsory	
	International Production Management: Specialisation Production	Technology: Elective Compulsory		
	International Management and Engineering: Specialisation II. Med	chatronics: Elective Compulsory		
	International Management and Engineering: Specialisation II. Pro	duct Development and Production: Electiv	ve Compulsory	
	Mechanical Engineering and Management: Core qualification: Co	mpulsory		
	Mechatronics: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation P	roduct Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	aterials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Deve	elopment and Production: Elective Compu	Ilsory	
	Theoretical Mechanical Engineering: Technical Complementary C	Course: Elective Compulsory		

Course L0168: Robotics: Modelling	and Control
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	Fundamental kinematics of rigid body systems
	Newton-Euler equations for manipulators
	Trajectory generation
	Linear and nonlinear control of robots
Literature	Craig, John J.: Introduction to Robotics Mechanics and Control, Third Edition, Prentice Hall. ISBN 0201-54361-3
	Spong, Mark W.; Hutchinson, Seth; Vidyasagar, M. : Robot Modeling and Control. WILEY. ISBN 0-471-64990-2



Course L1305: Robotics: Modelling and Control		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Uwe Weltin	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0771: Flight Physi	cs			
· · ·				
Courses				
Title		Тур	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L07	27)	Lecture	3	3
Flight Mechanics II (L0730) Flight Mechanics II (L0731)		Lecture Recitation Section (large)	2	2
	Prof. Frank Thielecke	Recitation Section (large)	I	I
	None			
	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following	Aircraft Systems Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II.	Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulsor	y	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy	stems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complemental	y Course: Elective Compulsory		

Course L0727: Aerodynamics and F	Flight Mechanics I
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Ralf Heinrich, Mike Montel
Language	DE
Cycle	WiSe
Content	<ul> <li>Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows)</li> <li>Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)</li> </ul>
Literature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>



Course L0730: Flight Mechanics II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	<ul> <li>stationary asymmetric flight</li> <li>dynamics of lateral movement</li> <li>methods of flight simulation</li> <li>eyperimental methods of flight mechanics</li> <li>model validation using system identification</li> <li>wind tunnel techniques</li> </ul>
Literature	<ul> <li>Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II</li> <li>Etkin, B.: Dynamics of Atmospheric Flight</li> <li>Sachs/Hafer: Flugmechanik</li> <li>Brockhaus: Flugregelung</li> <li>J.D. Anderson: Introduction to flight</li> </ul>

Course L0731: Flight Mechanics II	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Klaus-Uwe Hahn, Dr. Gerko Wende
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0815: Product Pla	anning			
Courses				
Title		Тур	Hrs/wk	CP
Product Planning (L0851)		Problem-based Learning	3	3
Product Planning (20031) Product Planning Seminar (20853)		Problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt			
Admission Requirements	None			
Recommended Previous	Good basic-knowledge of Business Administration			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	rnina results		
Professional Competence	The laking part buccession, stadents have rederied are following fea			
Knowledge	Students will gain insights into:			
Knowledge				
	Product Planning			
	• Process			
	<ul> <li>Methods</li> </ul>			
	Design thinking			
	<ul> <li>Process</li> </ul>			
	<ul> <li>Methods</li> </ul>			
	<ul> <li>User integration</li> </ul>			
Skills	Students will gain deep insights into:			
	Product Planning			
	<ul> <li>Process-related aspects</li> </ul>			
	<ul> <li>Organisational-related aspects</li> </ul>			
	<ul> <li>Human-Ressource related aspects</li> </ul>			
	<ul> <li>Working-tools, methods and instruments</li> </ul>			
	0			
D				
Personal Competence				
Social Competence	Interact within a team			
	<ul> <li>Raise awareness for globabl issues</li> </ul>			
Autonomy	<ul> <li>Gain access to knowledge sources</li> </ul>			
	Interpret complex cases			
	Develop presentation skills			
<b></b>				
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	Global Innovation Management: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation I. Elective			
	Mechanical Engineering and Management: Specialisation Manageme			
	Product Development, Materials and Production: Specialisation Produ	ct Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation Produ			
	Product Development, Materials and Production: Specialisation Mater			
	Theoretical Mechanical Engineering: Specialisation Product Developm		ulsory	
	Theoretical Mechanical Engineering: Technical Complementary Cour	se: Elective Compulsory		

Course L0851: Product Planning	
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process
	This integrated lecture is designed to understand major issues, activities and tools in the context of systematic product planning, a key activity for managing the front-end of innovation, i.e.:
	Systematic scanning of markets for innovation opportunities
	Understanding strengths/weakness and specific core competences of a firm as platforms for innovation
	<ul> <li>Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.)</li> <li>Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment</li> <li>Transferring ideas for innovation into feasible concepts which have a high market attractively</li> </ul>
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010



Course L0853: Product Planning Se	Course L0853: Product Planning Seminar		
Тур	Problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Cornelius Herstatt		
Language	EN		
Cycle	WiSe		
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly		
Literature	see/siehe Vorlesung Produktplanung/Product Planning		



Module M0830: Environme	ntal Protection and Management			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Pollution Control (L0502)		Lecture	2	2
Health, Safety and Environmental Manage	nent (L0387)	Lecture	2	3
Health, Safety and Environmental Manage	ment (L0388)	Recitation Section (small)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	• Cood lacouladas in Trabaclasias for Fraincast			
Knowledge	<ul> <li>Good knowledge in Technologies for Environmenta</li> <li>Good knowledge of the relevant Environmental Leg</li> </ul>			
	Basic knowledge of instruments for Environmental	•		
		Assessment		
Educational Objectives	After taking part successfully, students have reached the for	llowing learning results		
Professional Competence				
Knowledge	The students are able to describe the basics of regulation	ons, economic instruments, voluntary initiatives,	fundamentals of HS	E legislation ISO 140
	EMAS and Responsible Care ISO 14001 requirements. Th	ey can analyse and discuss industrial processes	s, substance cycles a	nd approaches from er
	of-pipe technology to eco-efficiency and eco-effectiveness	, showing their sound knowledge of complex ind	ustry related problem	ns. They are able to jud
	environmental issues and to widely consider, apply or carr	y out innovative technical solutions, remediation	measures and furthe	er interventions as well
	conceptual problem solving approaches in the full range of	f problems in different industrial sectors.		
Skills	Students are able to assess current problems and situation	ons in the field of environmental protection. The	ey can consider the I	pest available techniqu
	and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative			
	and legislative level.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare th	emselves for presentations and contributions to	the discussions. The	y can acquire appropri
	knowledge by making enquiries independently.			
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	Energy and Environmental Engineering: Specialisation En	vironmental Engineering: Elective Compulsory		
Curricula	Environmental Engineering: Core qualification: Compulso	ry		
	Joint European Master in Environmental Studies - Cities a	nd Sustainability: Specialisation Water: Elective	Compulsory	
	Joint European Master in Environmental Studies - Cities a	nd Sustainability: Specialisation Energy: Elective	Compulsory	
	Product Development, Materials and Production: Specialis	ation Product Development: Elective Compulsor	У	
	Product Development, Materials and Production: Specialis	ation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialis	ation Materials: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Env	ironment: Compulsory		
	Water and Environmental Engineering: Specialisation Citie	en Commulation		



Course L0502: Integrated Pollution C	Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The Regulatory Framework
	<ul> <li>Pollution &amp; Impacts, Characteristics of Pollutants</li> <li>Approaches of Integrated Pollution Control</li> <li>Sevilla Process, Best Available Technologies &amp; BREF Documents</li> <li>Case Studies: paper industry, cement industry, automotive industry</li> <li>Field Trip</li> </ul>
	Förstner, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 Shen, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety and E	nvironmental Management
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

purse L0388: Health, Safety and Environmental Management			
Тур	Typ Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Hans-Joachim Nau		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0867: Productior	Planning & Control and Digital Enternation	erprise			
Courses					
Title		Тур	Hrs/wk	CP	
The Digital Enterprise (L0932)		Lecture	2	2	
Production Planning and Control (L0929)		Lecture	2	2	
Production Planning and Control (L0930)		Recitation Section (small)	1	1	
Exercise: The Digital Enterprise (L0933)		Recitation Section (small)	1	1	
Module Responsible	Prof. Hermann Lödding				
Admission Requirements	None				
Recommended Previous	Fundamentals of Production and Quality Manage	ement			
Knowledge					
Educational Objectives	After taking part successfully, students have reac	hed the following learning results			
Professional Competence					
Knowledge	Students can explain the contents of the module	in detail and take a critical position to them.			
Skills	Students are capable of choosing and applying r	Students are capable of choosing and applying models and methods from the module to industrial problems.			
Personal Competence					
Social Competence		Students can develop joint solutions in mixed teams and present them to others.			
Autonomy					
Workload in Hours		ire 84			
Credit points	6				
Examination	Written exam				
Examination duration and scale	180 Minuten				
Assignment for the Following	International Management and Engineering: Spe	ecialisation II. Product Development and Production: Elect	tive Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Specialisati	on Production and Logistics: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial	Organs and Regenerative Medicine: Elective Compulsor	y		
	Biomedical Engineering: Specialisation Implants	and Endoprostheses: Elective Compulsory			
	Biomedical Engineering: Specialisation Medical	Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Manage	ment and Business Administration: Compulsory			
	Product Development, Materials and Production:	Specialisation Product Development: Elective Compulso	ry		
	Product Development, Materials and Production:	Specialisation Production: Compulsory			
	Product Development, Materials and Production:	Specialisation Materials: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisat	tion Product Development and Production: Elective Comp	ulsory		
	Theoretical Mechanical Engineering: Technical C	Complementary Course: Elective Compulsory			

Course L0932: The Digital Enterpris	e
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, AW.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006



Course L0929: Production Planning	and Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	<ul> <li>Models of Production and Inventory Management</li> <li>Production Programme Planning and Lot Sizing</li> <li>Order and Capacity Scheduling</li> <li>Selected Strategies of PPC</li> <li>Manufacturing Control</li> <li>Production Controlling</li> <li>Supply Chain Management</li> </ul>
Literature	<ul> <li>Vorlesungsskript</li> <li>Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008</li> <li>Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002</li> </ul>

Course L0930: Production Planning and Control		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0933: Exercise: The Digita	ourse L0933: Exercise: The Digital Enterprise		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Axel Friedewald		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	Siehe korrespondierende Vorlesung		
	See interlocking course		



Module M0962: Sustainabil	ity and Risk Management			
Courses				
Title		Тур	Hrs/wk	CP
Safety, Reliability and Risk Assessment (L	.1145)	Seminar	2	3
Environment and Sustainability (L0319)		Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students are able to describe single techniques and to give a	n overview for the field of safety a	nd risk assessment as wel	l as environmental and
	sustainable engineering, in detail:			
	<ul> <li>basics in safety and reliability of technical facilities</li> </ul>			
	<ul> <li>safety and reliability analysis methods</li> </ul>			
	risk assessment			
	Production and usage of bio-char			
	energy production and supply			
	sustainable product design			
Skills	Students are able apply interdisciplinary system-oriented metho costs for processes and select economically feasible treatment or		ability reporting. They can	evaluate the effort and
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from given so	urces and transform it to new ques	tions. Furthermore, they car	n define targets for new
	application or research-oriented duties in for risk management a			
	impact.			
	•			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minutes in groups)			
Assignment for the Following	Civil Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation II. Civ	il Engineering: Elective Compulsory		
	Product Development, Materials and Production: Specialisation F	Product Development: Elective Comp	oulsory	
	Product Development, Materials and Production: Specialisation F	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	Naterials: Elective Compulsory		
	Water and Environmental Engineering: Core qualification: Comp	ulsory		

Course L1145: Safety, Reliability an	d Risk Assessment
Тур	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski
Language	DE
Cycle	WiSe
Content	<ul> <li>An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated:</li> <li>basics in safety and reliability of technical facilities</li> <li>safety and reliability analysis methods</li> <li>risk assessment</li> <li>practical examples and excursions</li> <li>discussions and presentations</li> </ul>
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/ <b>sicherheit_</b> und_zuverlaessigkeit.pdf



Course L0319: Environment and Su	stainability
	Lecture
Hrs/wk	
CP	
-	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Kerstin Kuchta
Language	
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of
	energy supply, product design, water supply, waste water treatment or mobility. The following list show examples.
	Production and Usage of Bio-char
	Engergy production with algae
	Environmental product design
	Clean Development mechanism (CDM)
	Democracy and Energy
	New Concepts for a sustainable Energy Supply
	Recycling of Wind Turbines
	Alternative Mobility
	Disposal of Nuclear Wastes
	Waste2Energy
	Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.



Module M1002: Production	and Logistics Management			
Courses				
Title		Тур	Hrs/wk	CP
Operative Production and Logistics Mana	pement (L1198)	Lecture	2	2
Strategic Production and Logistics Manag		Problem-based Learning	3	4
Module Responsible	Prof. Wolfgang Kersten			
Admission Requirements	None			
Recommended Previous	Introduction to Business and Management			
Knowledge				
	The province knowledge, that is personally for the successful	acticipation in this module is accessable vi	a a looming Log in a	nd additional informati
	The previous knowledge, that is necessary for the successful will be distributed during the admission process.	barticipation in this module is accessable via	a e-leanning. Log-in a	nu auditional informati
	will be distributed during the admission process.			
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results		
Professional Competence				
Knowledge	Students will be able			
	<ul> <li>to differentiate between strategic and operational productio</li> </ul>			
	<ul> <li>to describe the areas of production and logistics management</li> </ul>			
	- understand the difference between traditional and new concepts of production planning and control,			
	<ul> <li>to describe and explain the actual challenges of production</li> </ul>	and logistics management, esp. in an intern	iational context.	
Skills				
	Based on the acquired knowledge students are capable of			
	- Applying methods of production and logistics management	in an international context,		
	- Selecting sufficient methods of production and logistics man	nagement to solve practical problems,		
	<ul> <li>Selecting appropriate methods of production and logistics r</li> </ul>			
	<ul> <li>Making a holistic assessment of areas of decision in produce</li> </ul>	tion and logistics management and relevant	t influence factors.	
Personal Competence				
Social Competence	After completion of the module students can			
	<ul> <li>lead discussions and team sessions,</li> </ul>			
	- arrive at work results in groups and document them,	a the area		
	<ul> <li>develop joint solutions in mixed teams and present them to present colutions to appoint and develop ideas further.</li> </ul>	others,		
Autonomy	- present solutions to specialists and develop ideas further. After completion of the module students can			
Autonomy	Alter completion of the module students can			
	- assess possible consequences of their professional activity,			
	- define tasks independently, acquire the requisite knowledge	and use suitable means of implementation.		
	- define and carry out research tasks bearing in mind possible	societal consequences.		
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	International Management and Engineering: Core qualification	a: Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Comp	ulsory		
	Product Development, Materials and Production: Specialisatio	n Product Development: Elective Compulsor	ry	
	Product Development, Materials and Production: Specialisatio	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisatio	n Materials: Elective Compulsory		



Course L1198: Operative Production	n and Logistics Management
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Blecker
Language	DE
Cycle	WiSe
Content	Further knowledge of operational production management
	Traditional production planning and control concepts
	Recent production planning and control concepts
	Understanding and application of quantitative methods     Turther approximate approxi
	Further concepts regarding operational production management
Literature	
	Corsten, H.: Produktionswirtschaft: Einführung in das industrielle Produktionsmanagement, 12. Aufl., München 2009.
	Dyckhoff, H./Spengler T.: Produktionswirtschaft: Eine Einführung, 3. Aufl., Berlin Heidelberg 2010.
	Heizer, J/Render, B: Operations Management, 10. Auflage, Upper Saddle River 2011.
	Kaluza, B./Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in Virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.
	Kaluza, B./Blecker, Th. (Hrsg.): Erfolgsfaktor Flexibilität. Strategien und Konzepte für wandlungsfähige Unternehmen, Berlin 2005.
	Kurbel, K.: Produktionsplanung und steuerung, 5., Aufl., München - Wien 2003.
	Schweitzer, M.: Industriebetriebslehre, 2. Auflage, München 1994.
	Thonemann, Ulrich (2005): Operations Management, 2. Aufl., München 2010.
	Zahn, E./Schmid, U.: Produktionswirtschaft I: Grundlagen und operatives Produktionsmanagement, Stuttgart 1996
	Zäpfel, G.: Grundzüge des Produktions- und Logistikmanagement, 2. Aufl., München - Wien 2001



Тур	Problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	WiSe
Content	<ul> <li>Identification of the scope of production, operations and logistics management</li> <li>Understanding of actual challenges concerning production and logistics strategy</li> <li>Understanding operations as a competitive weapon</li> <li>Identification and design of the main elements of an operations strategy (level of vertical integration, technology strategy, location strategy, capacity strategy) of a company</li> <li>Evaluation of operation strategies of different companies and industrial sectors</li> <li>In depth discussion of methods and concepts of production and logistics management</li> <li>In depth discussion of lean management: Main goals and measures of lean management and lean production concepts, impact of lean management on production strategy</li> <li>Presentation and discussion of current research topics in the field of production and logistics management</li> <li>Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills</li> </ul>
Literature	Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung in das industrielle Produktionsmanagement, 12. Auflage, München: Oldenbourg.
	Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. Auflage, Berlin Heidelberg [u.a.]: Springer.
	Heizer, J/Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.
	Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.
	Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage, Frankfurt/Main [u.a.]: Campus-Verlag.
	Slack, N./ Lewis, M.(2002): Operations Strategy, Harlow u.a.
	Swink, M./ Melnyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a.
	Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Computers in Industry 19, S. 79-88
	Womack, J./ Jones, D./ Roos, D. (1990): The Machine that changed the world; New York.
	Zahn, E. /Schmid, U. (1996): Grundlagen und operatives Produktionsmanagement, Stuttgart: Lucius & Lucius
	Zäpfel, G.(2000): Produktionswirtschaft: Strategisches Produktions-Management, 2. Aufl., München u.a.



Module M1024: Methods of	Integrated Product Development			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Product Development II (L1254)		Lecture	3	3
Integrated Product Development II (L1255)		Problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Basic knowledge of Integrated product development and applying	ng CAE systems		
Knowledge				
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:			
	<ul> <li>explain technical terms of design methodology,</li> </ul>			
	<ul> <li>describe essential elements of construction management</li> </ul>	ıt,		
	<ul> <li>describe current problems and the current state of resea</li> </ul>			
Skills	After passing the module students are able to:			
	select and apply proper construction methods for non-sta		as adapt new boundary	conditions,
	<ul> <li>solve product development problems with the assistance</li> <li>choose and execute appropriate moderation techniques</li> </ul>			
	<ul> <li>choose and execute appropriate moderation techniques</li> </ul>	•		
Personal Competence				
Social Competence	After passing the module students are able to:			
	prepare and lead team meetings and moderation proces	sses,		
	<ul> <li>work in teams on complex tasks,</li> </ul>			
	represent problems and solutions and advance ideas.			
Autonomy	After passing the module students are able to:			
	<ul> <li>give a structured feedback and accept a critical feedback</li> </ul>	ς,		
	implement the accepted feedback autonomous.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 Minuten			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Cabin Systems: Ele	ective Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation	Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II. P	roduct Development and Production: Elec	tive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulse	ory		
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Theoretical Mechanical Engineering: Technical Complementary			
	Theoretical Mechanical Engineering: Specialisation Product De	velopment and Production: Elective Comp	oulsory	



Course L1254: Integrated Product D	levelopment II
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Lecture
	The lecture extends and enhances the learned content of the module "Integrated Product Development and lightweight design" and is based on the knowledge and skills acquired there.
	Topics of the course include in particular:
	Methods of product development,
	Presentation techniques,
	Industrial Design,
	Design for variety
	Modularization methods,
	• Design catalogs,
	Adapted QFD matrix,
	Systematic material selection,
	Assembly oriented design,
	Construction management
	CE mark, declaration of conformity including risk assessment,
	Patents, patent rights, patent monitoring
	<ul> <li>Project management (cost, time, quality) and escalation principles,</li> </ul>
	Development management for mechatronics,
	Technical Supply Chain Management.
	Exercise (PBL)
	In the exercise the content presented in the lecture "Integrated Product Development II" and methods of product development and design managemen will be enhanced.
	Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currentl existing issues in product development. They will learn the ability to apply important methods of product development and design managemer autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussion and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	Andressen MMA Design for Assembly Dedia Project 1005
	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.     Ashby, M.E.: Materiala Selection in Mechanical Design, München, Speltrum 2007.
	<ul> <li>Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.</li> <li>Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.</li> </ul>
	<ul> <li>Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.</li> <li>Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch f ür F ührungskr äfte, Berater und Trainer, Weinheim, Bell</li> </ul>
	<ul> <li>Hartmann, M., Rieger, M., Funk, R., Hath, U.: Zieigerichtet moderieren. Ein Handbuch für Funrungskratte, Berater und Trainer, Weinneim, Beit 2007.</li> </ul>
	<ul> <li>Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.</li> </ul>
	<ul> <li>Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000.</li> <li>Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.</li> </ul>
	• Ompson, 1.vr., Obuique, 2., oldu, n.u., Froudul Flationn and Froudul Flating Design. Inethous and Applications, New York, Springer 2013.

Course L1255: Integrated Product E	Course L1255: Integrated Product Development II	
Тур	Problem-based Learning	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1025: Fluidics				
Courses				
<b>Title</b> Fluidics (L1256) Fluidics (L1371)		Typ Lecture Problem-based Learning	<b>Hrs/wk</b> 2 1	<b>CP</b> 3 2
Fluidics (L1257)	Def Distantian	Recitation Section (large)	1	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements Recommended Previous		tation (line and line time) (line time)		vien desien
Knowledge	Good knowledge of mechanics (stereo statics, elastostatics, hydros	aucs, kinematics and kinetics), iluid m	lechanics, and enginee	nng design
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence	Alter taking part successiony, students have reached the following r	earning results		
Knowledge	After passing the module students are able to	P		
	<ul> <li>explain structures and functionalities of hydrostatic, pneuma</li> <li>explain the interaction of hydraulic components in hydraulic</li> <li>explain open and closed loop control of hydraulic systems,</li> <li>describe functioning and applications of hydrodynamic torc plant technology</li> </ul>	systems,	as well as centrifugal p	umps and aggregates
Skills	After passing the module students are able to <ul> <li>analyse and assess hydraulic and pneumatic components a</li> <li>design and dimension hydraulic systems for mechanical app</li> <li>perform numerical simulations of hydraulic systems based o</li> <li>select and adapt pump characteristic curves for hydraulic sy</li> <li>dimension hydrodynamic torque converters and brakes for r</li> </ul>	plications, n abstract problem definitions, stems		
Personal Competence Social Competence	After passing the module students are able to			
	<ul> <li>discuss and present functional context in groups,</li> <li>organise teamwork autonomously.</li> </ul>			
Autonomy	After passing the module students are able to <ul> <li>obtain necessary knowledge for the simulation.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Mech International Management and Engineering: Specialisation II. Prodi Product Development, Materials and Production: Specialisation Pro Product Development, Materials and Production: Specialisation Pro Product Development, Materials and Production: Specialisation Ma	uct Development and Production: Elec duct Development: Compulsory duction: Elective Compulsory	ctive Compulsory	
	Theoretical Mechanical Engineering: Specialisation Product Develor Theoretical Mechanical Engineering: Technical Complementary Co	opment and Production: Elective Com	pulsory	



ourse L1256: Fluidics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	Lecture
	Hydrostatics
	physical fundamentals
	hydraulic fluids
	hydrostatic machines
	• valves
	components
	hydrostatic transmissions
	examples from industry
	Pneumatics
	generation of compressed air
	pneumatic motors
	Examples of use
	Hydrodynamics
	physical fundamentals
	hydraulic continous-flow machines
	hydrodynamic transmissions
	interoperation of motor and transmission
	Exercise
	Hydrostatics
	reading and design of hydraulic diagrams
	dimensioning of hydrostatic traction and working drives
	performance calculation
	Hydrodynamics
	calculation / dimensioning of hydrodynamic torque converters
	calculation / dimensioning of reputibulginatine torque conveners     calculation / dimensioning of centrifugal pumps
	<ul> <li>creating and reading of characteristic curves of pumps and systems</li> </ul>
	Field trip
	<ul> <li>field trip to a regional company from the hydraulic industry.</li> </ul>
	Exercise
	Numerical simulation of hydrostatic systems
	getting to know a numerical simulation environment for hydraulic systems
	<ul> <li>transformation of a task into a simulation model</li> </ul>
	simulation of common components
	variation of simulation parameters
	using simulations for system dimensioning and optimisation
	(partly) self-organised teamwork
Literature	Bücher
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011
	<ul> <li>Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006</li> </ul>
	<ul> <li>Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006</li> </ul>
	<ul> <li>Beitz, W., Grote, KH.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage</li> </ul>
	Skript zur Vorlesung



Course L1371: Fluidics		
Тур	Problem-based Learning	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	
Course L1257: Fluidics		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	

	CF	
	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
	Lecturer	Prof. Dieter Krause
	Language	DE
	Cycle	WiSe
ĺ	Content	See interlocking course
	Literature	See interlocking course



Module M1155: Aircraft Cal	oin Svstems			
Courses				
Title		Тур	Hrs/wk	CP
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous	Basic knowledge in:			
Knowledge	Mathematics			
	Mechanics			
	Thermodynamics			
	Electrical Engineering			
	Control Systems			
Educational Obj	After dell'estantico de la construcción de la della de la construcción de la della della della della della della	for the other second to		
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and cabin			
	explain the functional and non-functional requirements for ca			
	elucidate the necessity of cabin operating systems and emer			
	<ul> <li>assess the challenges human factors integration in a cabin e</li> </ul>	nvironment		
Skills	Students are able to:			
	<ul> <li>design a cabin layout for a given business model of an Airling</li> </ul>	9		
	design cabin systems for safe operations			
	<ul> <li>design emergency systems for safe man-machine interaction</li> </ul>			
	<ul> <li>solve comfort needs and entertainment requirements in the c</li> </ul>	abin		
Personal Competence				
Social Competence	Students are able to:			
	understand existing system solutions and discuss their ideas	with experts		
Autonomy	Students are able to:			
	Reflect the contents of lectures and expert presentations self	dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Elective Con	npulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory			
	International Management and Engineering: Specialisation II.			
	Product Development, Materials and Production: Specialisation	n Product Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisation	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Sy	stems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementa	ry Course: Elective Compulsory		



Course L1545: Aircraft Cabin Syste	ms
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved.
	The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion
Literature	<ul> <li>Skript zur Vorlesung</li> <li>Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999</li> <li>Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014</li> <li>Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008</li> <li>Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003</li> <li>Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006</li> <li>Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006</li> </ul>

Course L1546: Aircraft Cabin Systems	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M1174: Automation	n Technology and Systems			
Courses				
litle		Tun	Hrs/wk	CP
		Тур		
landling and Assembly Systems (L1591) landling and Assembly Systems (L1738)		Lecture	2	2
		Recitation Section (small) Lecture	2	2
utomation Technology (L1590) utomation Technology (L1739)		Recitation Section (small)	2	2
	Des ( The sector Oak " as a ball	necitation Section (Smail)	I	I
Module Responsible Admission Requirements	Prof. Thorsten Schüppstuhl None			
Recommended Previous	without major course assessment			
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	Students			
	<ul> <li>know the characteristic components of an</li> </ul>	n automation systems and have good understanding of the	ir interaction	
		s of automation tasks and are able to use them		
	<ul> <li>have special competences in industrial m</li> </ul>			
Skills	Students are able to			
	and a second			
	analyze complex Automation tasks			
	<ul> <li>develop application based concepts and</li> </ul>			
	<ul> <li>design subsystems and integrate into on</li> </ul>			
	<ul> <li>investigate and evaluate safety of machine</li> </ul>			
	<ul> <li>create simple programs for robots and pr</li> </ul>	rogrammable logic controllers		
	design of circuit for pneumatic applicatio	ns		
Personal Competence				
Social Competence	Students are able to			
	- find solutions for automation and handling task	ks in groups		
	- develop solutions in a production environment	t with qualified personnel at technical level and represent of	lecisions.	
Autonomy	Students are able to			
	<ul> <li>analyze automation tasks independently</li> </ul>	,		
	<ul> <li>generate programs for robots and program</li> </ul>			
	<ul> <li>develop solutions for practice oriented ta</li> </ul>			
	<ul> <li>design safety concepts for automation ap</li> </ul>	, ,		
	<ul> <li>assess consequences of their profession</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Product Development, Materials and Production	n: Specialisation Product Development: Elective Compulsor	у	
Curricula	Product Development, Materials and Production	n: Specialisation Production: Compulsory		
	Product Development, Materials and Production	: Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical	Complementary Course: Elective Compulsory		

Course L1	591: Handling and Assembly Systems
Тур	Lecture
Hrs/wk	2
CP	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
Content	Fundamentals and terminology of handling and assembly systems -Analysis of parts and handling tasks -Supply and transfer systems -Gripper -Industrial robots: structure, control and programming -Safety of machinery
Literature	Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010



	738: Handling and Assem Typ	Recitation Section (small)		
	Hrs/wk			
	CP	1		
	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
	Lecturer	Prof. Thorsten Schüppstuhl		
	Language	DE		
	Cycle	WiSe		
	Content	See interlocking course		
	Literature	See interlocking course		
	590: Automation Technol	ogy		
Тур	Lecture 2			
Hrs/wk CP	2			
Workload		32, Study Time in Lecture 28		
in Hours	independent olddy Tille			
Lecturer	Prof. Thorsten Schüppstu	hl		
Language	DE			
Cycle	SoSe			
	<ul> <li>-Overview of different actuator concepts and their principles</li> <li>-Design of pneumatic wiring diagrams</li> <li>-Energyefficency in the production</li> <li>-Review of automatic identification systems like Barcode and RFID</li> <li>-Overview of the structure, components and algorithms of an image processing system</li> <li>-Introduction to buscommunication an the different general concepts</li> <li>-Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends</li> </ul>			
Literature	Reinhard Langmann:	Taschenbuch der Automatisierung		
	Holger Watter: Hydra	ulik und Pneumatik		
	Horst Walter Grollius: Grundlagen der Pneumatik Hubertus Murrenhoff: Grundlagen der Fluidtechnik			
	Christian Demant: Inc	dustrielle Bildverarbeitung		
	Michael ten Hompel:	Identifikationssysteme und Automatisierung		

Course L1739: Automation Technology		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		



Module M1183: Laser syste	ems and methods of manufacturing desig	yn and analysis		
Courses				
Title		Тур	Hrs/wk	CP
Laser Systems and Process Technologies	s (L1612)	Lecture	2	3
Methods for Analysing Production Process	ses (L0876)	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following	Product Development, Materials and Production: Specia	alisation Product Development: Elective Con	npulsory	
Curricula	Product Development, Materials and Production: Specia	alisation Production: Compulsory		
	Product Development, Materials and Production: Specia	alisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Pro	duct Development and Production: Elective	Compulsory	
	Theoretical Mechanical Engineering: Technical Comple	mentary Course: Elective Compulsory		

Course L1612: Laser Systems and	Process Technologies
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Claus Emmelmann
Language	EN
Cycle	WiSe
Content	<ul> <li>Fundamentals of laser technology</li> <li>Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers</li> <li>Laser system technology: beam forming, beam guidance systems, beam motion and beam control</li> <li>Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment</li> <li>Quality assurance and economical aspects of laser material processing</li> <li>Markets and Applications of laser technology</li> <li>Student group exercises</li> </ul>
Literature	<ul> <li>Hügel, H., T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014.</li> <li>Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010.</li> <li>Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010.</li> <li>J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005.</li> <li>Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011</li> </ul>



Course L0876: Methods for Analysi	ng Production Processes
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Modelling and simulation of maching and forming processes</li> <li>Numerical simulation of forces, temperatures, deformation in machining</li> <li>Analysis of vibration problems in maching (chatter, modal analysis,)</li> <li>Knowledge based process planning</li> <li>Design of experiments</li> <li>Machinability of nonmetallic materials</li> <li>Analysis of interaction between maching process and machine tool systems with regard to process stability and quality</li> <li>Simulation of maching processes by virtual reality methods</li> </ul>
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)

Module M0719: Biomaterial	s and Regenerative Medicine				
Courses					
Title		Тур	Hrs/wk	CP	
Biomaterials (L0593)		Lecture	2	3	
Regenerative Medicine (L0347)		Seminar	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous	Basic knowledge of surgical techniques and of imp	lants and endoprotheses are recommended.			
Knowledge					
Educational Objectives	After taking part successfully, students have reache	ed the following learning results			
Professional Competence					
Knowledge	The students can describe the material characterist	tics of materials used in medical engineering, includi	ng their advantages and	disadvantages.	
	The students can name the polymers, metals and synthetic materials used in humans.				
	The student has a basic understanding on issues of regenerative medicine.				
Skills	The students can explain the advantages and disa	dvantages of the materials used in medical engineer	ing.		
	The student can explain and describe the basic principles of cell use for regenerative medical applications.				
	The student can use literature databases for accum	nulation and presentation of relevant up-to-date data.			
Personal Competence					
Social Competence	The student can lead discussions and participate in	n them, representing work results.			
	The student can respectfully and adequately work i	in a team with his peers.			
Autonomy	The student has the ability to acquire knowledge in	dependently and transfer the acquired knowledge to	new issues.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 minutes, between 20 and 50 questions				
Assignment for the Following	Product Development, Materials and Production: S	pecialisation Materials: Elective Compulsory			
Curricula		· · ·			



Typ       Lecture         Hrawk       2         OP       3         Workload in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecture       Pol.         Option       Topics to be covered include:         Option       Topics to be covered include:         1       Introduction (Importance, nomenclature, relations)         2.       Biological materials         2.1       Instruction, development, properties, influencing factors)         2.3       Cartilage (composition, development, properties, influencing factors)         2.4       Fludes (blood, synovial fluid)         3       Biological structures         3.1       Menice of the knee joint         3.2       Intervertebral discs         3.3       Teefit         3.4       Ligaments         3.5       Tendors         3.6       Skin         3.7       Nervs         3.8       Marcies         4.1       Basics (history, requirements, norms)         4.2       Steel (hiolys, properties, reaction of the body)         4.3       Steel (ultoys, properties, reaction of the body)         4.4       Ligaments, and gias (properties, reaction of the body)         4.5 <th>Course L0593: Biomaterials</th> <th></th>	Course L0593: Biomaterials		
Hrawk       2         OP 3         Worklaad in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecture       Prof. Michael Moriok         Language       EN         Oyde       Wils6         Content       Topics to be covered include:         1.       Introduction (Inportance, nomenclature, relations)         2.       Biological materials         2.1       Basics (components, testing methods)         2.2       Bone (composition, development, properties, influencing factors)         2.3       Cartiage (composition, development, properties, influencing factors)         2.4       Fuida (block, synovial fluid)         3       Biological structure, properties, influencing factors)         2.4       Fuida (block, synovial fluid)         3       Intervetebral discs         3.3       Tech         3.4       Ligaments         3.5       Fandona         3.6       Kin         3.7       Nervs         3.8       Muzcles         4.       Replacement materials         4.       Replacement materials         4.3       Tain (alicys, properties, reaction of the body)         4.4       Carmics and glas (properties, reaction		Lecture	
Workload in Hours         Independent Study Time 82, Study Time in Lecture 28           Lecture         Prof. Michael Moriock           Language         FN           Corter         Topics to be overred include:           1.         Introduction (Importance, nomenclature, relations)           2.         Biological materials           2.1         Basics (components, lesing methods)           2.2         Bone (composition, development, structure, properties, influencing factors)           2.3         Cardiage (composition, development, structure, properties, influencing factors)           2.4         Fluids (blood, synoxial fluid)           3         Biological structures           3.1         Menisci of the knee joint           3.2         Interventobral discs           3.3         Teeth           3.4         Ligaments           3.5         Tendons           3.6         Skin           3.7         Nerve           3.8         Muscles           4.1         Replacement materials           4.2         Steel (alloys, properties, reaction of the body)           4.3         Steel (alloys, properties, reaction of the body)           4.4         Caranics and glas (propertises, reaction of the body)           4.			
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Language         EN           Cycle         WSe           Content         Topics to be covered include:           1.         lstoduction (Importance, nomenclature, relations)           2.         Biological materials           2.1         Biasics (composition, development, properties, influencing factors)           2.2         Bone (composition, development, properties, influencing factors)           2.3         Carrilage (composition, development, properties, influencing factors)           2.4         Fluids (blood, synovial fluid)           3         Biological structures           3.1         Menisoi of the knee joint           3.2         Interventebral discs           3.3         Teeth           3.4         Ligaments           3.5         Tendors           3.8         Skin           3.7         Nerve           3.8         Muscles           4.         Replacement materials           4.1         Basics (history, requirements, norms)           4.2         See( alloys, properties, reaction of the body)           4.3         Titan (alloys, properties, reaction of the body)           4.4         Caramics and glas (properties, reaction of the body)           4.4         Caramics and glas (pro	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Cycle         WiSe           Content         Topics to be covered include::           1.         Introduction (Importance, nomenclature, relations)           2.         Biological materials           2.1         Basics (composition, development, properfies, influencing factors)           2.2         Bone (composition, development, structure, properfies, influencing factors)           2.4         Fluids (blood, synovial fluid)           3         Biological structures           3.1         Meniaci of the knee joint           3.2         Interventeburd blocs           3.3         Teeth           3.4         Ligaments           3.5         Tendons           3.6         Skin           3.7         Nervs           3.8         Muscles           4.         Replacement materials           4.1         Basics (history, requirements, norms)           4.2         Steel (alloys, properfies, reaction of the body)           4.3         Titan (alloys, properfies, reaction of the body)           4.4         Ceramics and glas (properfies, reaction of the body)           4.5         Plastics (properfies, reaction of the body)           4.6         Natural replacement materials           Knowledge of composition, struct			
Context         Topics to be covered include:           1. Introduction (Importance, nomenciature, relations)         2.           2. Biological materials         2.1           2.1         Basics (composition, development, properties, influencing factors)           2.2         Bone (composition, development, properties, influencing factors)           2.3         Cartilage (composition, development, structure, properties, influencing factors)           2.4         Fluids (blood, synovial fluid)           3         Biological structures           3.1         Menisci of the knee joint           3.2         Interventabral discs           3.3         Teeth           3.4         Ligaments           3.5         Fendons           3.6         Skin           3.7         Nervs           3.8         Muscles           4         Replacement materials           4.1         Basics (history, requirements, norms)           4.2         Steel (alloys, properties, reaction of the body)           4.3         Titan (alloys, properties, reaction of the body)           4.4         Ceramics and gias (properties, reaction of the body)           4.5         Plastics (properties of PMMA, HDPE, PET, reaction of the body)           4.6         Natural rep			
<ul> <li>Introduction (importance, nomenclature, relations)</li> <li>Biological materials</li> <li>Biological materials</li> <li>Basics (components, testing methods)</li> <li>Bone (composition, development, properties, influencing factors)</li> <li>Gartliage (composition, development, structure, properties, influencing factors)</li> <li>Gartliage (composition, development, structure, properties, influencing factors)</li> <li>Huids (blood, synovial fluid)</li> <li>Biological structures</li> <li>Intervertebral discs</li> <li>Intervertebral discs</li> <li>Intervertebral discs</li> <li>Tendons</li> <li>Stendons</li> <li>Kinewaters</li> <li>Stendons</li> <l< th=""><th></th><th></th></l<></ul>			
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<ul> <li>3.5 Tendons</li> <li>3.6 Skin</li> <li>3.7 Nervs</li> <li>3.8 Muscles</li> <li>4. Replacement materials</li> <li>4.1 Basics (history, requirements, norms)</li> <li>4.2 Steel (alloys, properties, reaction of the body)</li> <li>4.3 Titan (alloys, properties, reaction of the body)</li> <li>4.4 Ceramics and glas (properties, reaction of the body)</li> <li>4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)</li> <li>4.6 Natural replacement materials</li> <li>Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used)</li> </ul>		3.3 Teeth	
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<ul> <li>4. Replacement materials</li> <li>4.1 Basics (history, requirements, norms)</li> <li>4.2 Steel (alloys, properties, reaction of the body)</li> <li>4.3 Titan (alloys, properties, reaction of the body)</li> <li>4.4 Ceramics and glas (properties, reaction of the body)</li> <li>4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)</li> <li>4.6 Natural replacement materials</li> <li>Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used)</li> </ul>		3.7 Nervs	
<ul> <li>4.1 Basics (history, requirements, norms)</li> <li>4.2 Steel (alloys, properties, reaction of the body)</li> <li>4.3 Titan (alloys, properties, reaction of the body)</li> <li>4.4 Ceramics and glas (properties, reaction of the body)</li> <li>4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)</li> <li>4.6 Natural replacement materials</li> <li>Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used)</li> </ul>		3.8 Muscles	
<ul> <li>4.2 Steel (alloys, properties, reaction of the body)</li> <li>4.3 Titan (alloys, properties, reaction of the body)</li> <li>4.4 Ceramics and glas (properties, reaction of the body)</li> <li>4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)</li> <li>4.6 Natural replacement materials</li> <li>Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used)</li> </ul>		4. Replacement materials	
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4.6 Natural replacement materials Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are use		4.4 Ceramics and glas (properties, reaction of the body)	
Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are use			
		4.6 Natural replacement materials	
		Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used for replacements in-vivo). Acquisition of basics for theses work in the area of biomechanics.	
Literature Hastings G and Ducheyne P.: Natural and living biomaterials. Boca Raton: CRC Press, 1984.	Literature	Hastings G and Ducheyne P.: Natural and living biomaterials. Boca Raton: CRC Press, 1984.	
Williams D.: Definitions in biomaterials. Oxford: Elsevier, 1987.		Williams D.: Definitions in biomaterials. Oxford: Elsevier, 1987.	
Hastings G.: Mechanical properties of biomaterials: proceedings held at Keele University, September 1978. New York: Wiley, 1998.		Hastings G.: Mechanical properties of biomaterials: proceedings held at Keele University, September 1978. New York: Wiley, 1998.	
Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.		Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.	
Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.		Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.	
Wintermantel, E. und Ha, SW : Biokompatible Werkstoffe und Bauweisen. Berlin, Springer, 1996.		Wintermantel, E. und Ha, SW : Biokompatible Werkstoffe und Bauweisen. Berlin, Springer, 1996.	



Course L0347: Regenerative Medic	ine
Тур	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ralf Pörtner, Dr. Frank Feyerabend
Language	DE/EN
Cycle	SoSe
Content	The course deals with the application of biotechnological engineering principles for re-generation of human tissues. The main topics are "tissue engineering" for the generation of "artificial organs" such as cartilage, liver, blood vessel etc., and their applications: • Introduction (historical development, examples for medical and technical applications, commercial aspets) • Cell specific fundamentals (cell physiology, biochemistry, metabolism, special requirements for cell cultivation "in vitro") • Process specific fundamentals (requirements for culture systems, examples for reactor design, mathematical modelling, process and control strategies) • Examples for applications for clinical applications, drug testing and material testing The fundamentals will be presented by the lecturers. The "state of the art" of specific applications will be exploited by the students based on selected papers and presented during the course.
Literature	Regenerative Biology and Medicine (Taschenbuch) von David L. Stocum; Academic Pr Inc; ISBN-10: 0123693713, ISBN-13: 978-0123693716 Fundamentals of Tissue Engineering and Regenerative Medicine von Ulrich Meyer (Herausgeber), Thomas Meyer (Herausgeber), Jörg Handsch
	(Herausgeber), Hans Peter Wiesmann (Herausgeber): Springer, Berlin; ISBN-10: 3540777547; ISBN-13: 978-3540777540



Module M1185: Technical (	Complementary Course for PEPMS (according to Subject Specific Regulations)
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous	See selected module according to FSPO
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Examination	according to Subject Specific Regulations
Examination duration and scale	
Assignment for the Following	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory
Curricula	Product Development, Materials and Production: Specialisation Production: Elective Compulsory
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory



Module M1342: Polymers				
Courses				
Title		Тур	Hrs/wk	CP
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Processing and design with polymers (L18		Lecture	2	3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous	Basics: chemistry / physics / material science			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students can use the knowledge of plastics and defi	ne the necessary testing and analysis.		
	They can explain the complex relationships structure	e-property relationship and		
	the interactions of chemical structure of the polymer	s, including to explain neighboring contexts	s (e.g. sustainability, env	ironmental protection).
Skills	Students are capable of			
	- using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate th different materials.			
	- For mechanical recycling problems selecting appropriate solutions and sizing example Stiffness, corrosion resistance.			
Personal Competence				
Social Competence	Students can,			
	- arrive at work results in groups and document them.			
	- provide appropriate feedback and handle feedback	on their own performance constructively.		
Autonomy	Students are able to,			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.			
	- assess possible consequences of their professiona	l activity.		
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	Materials Science: Specialisation Engineering Materials			
Curricula	Biomedical Engineering: Specialisation Implants and En			
	Biomedical Engineering: Specialisation Artificial Organs	and Regenerative Medicine: Elective Compu	lsory	
	Biomedical Engineering: Specialisation Management ar	d Business Administration: Elective Compuls	ory	
	Biomedical Engineering: Specialisation Medical Techno	logy and Control Theory: Elective Compulsory	y	
	Product Development, Materials and Production: Specia	lisation Production: Elective Compulsory		
	Product Development, Materials and Production: Specia	lisation Materials: Elective Compulsory		
	Product Development, Materials and Production: Specia	lisation Product Development: Elective Comp	ulsory	
	Theoretical Mechanical Engineering: Specialisation Mat	erials Science: Elective Compulsory		



Course L0389: Structure and Properties of Polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
	Dr. Hans Wittich	
Language		
Cycle	WiSe	
Content	- Structure and properties of polymers	
	- Structure of macromolecules	
	Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution	
	- Morphology	
	amorph, crystalline, blends	
	- Properties	
	Elasticity, plasticity, viscoelacity	
	- Thermal properties	
	- Electrical properties	
	- Theoretical modelling	
	- Applications	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	

Course L1892: Processing and design with polymers		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich	
Language	DE/EN	
Cycle	WiSe	
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining	
	Designing with Polymers: Materials Selection; Structural Design; Dimensioning	
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag	
	Crawford: Plastics engineering, Pergamon Press	
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag	
	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	

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Thesis

Module M-002: Master Thesis		
ourses		
itle	Typ Hrs/wk CP	
Module Responsible	Professoren der TUHH	
Admission Requirements	<ul> <li>According to Conoral Degulations 824 (1):</li> </ul>	
	According to General Regulations §24 (1):	
	At least 78 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		
Ū	The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.	
	• The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing curr	
	developments and taking up a critical position on them.	
	<ul> <li>The students can place a research task in their subject area in its context and describe and critically assess the state of research.</li> </ul>	
Skills	The students are able:	
	• To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.	
	• To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defin	
	problems in a solution-oriented way.	
	<ul> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>	
Personal Competence		
Social Competence	Students can	
	<ul> <li>Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> </ul>	
	<ul> <li>Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding the second seco</li></ul>	
	own assessments and viewpoints convincingly.	
Autonomy	Students are able:	
	<ul> <li>To structure a project of their own in work packages and to work them off accordingly.</li> </ul>	
	<ul> <li>To work their way in depth into a largely unknown subject and to access the information required for them to do so.</li> </ul>	
	To apply the techniques of scientific work comprehensively in research of their own.	
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0	
Credit points	30	
Examination		
Examination duration and scale		
Assignment for the Following		
Curricula	Bioprocess Engineering: Thesis: Compulsory	
Guineula	Chemical and Bioprocess Engineering: Thesis: Compulsory	
	Computer Science: Thesis: Compulsory	
	Electrical Engineering: Thesis: Compulsory	
	Energy and Environmental Engineering: Thesis: Compulsory	
	Energy Systems: Thesis: Compulsory	
	Environmental Engineering: Thesis: Compulsory	
	Aircraft Systems Engineering: Thesis: Compulsory	
	Global Innovation Management: Thesis: Compulsory	
	Computational Science and Engineering: Thesis: Compulsory	
	Information and Communication Systems: Thesis: Compulsory	
	International Production Management: Thesis: Compulsory	
	International Management and Engineering: Thesis: Compulsory	
	International Management and Engineering. Thesis, compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory Ship and Offshore Technology: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory Ship and Offshore Technology: Thesis: Compulsory Theoretical Mechanical Engineering: Thesis: Compulsory	

