

Module Manual

Master of Science

Product Development, Materials and Production

Cohort: Winter Term 2016

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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 high-performance 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.

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

Courses

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



le M0524: Nontechnic	cal Elective Complementary Courses for Master
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-relian
	management, collaboration and professional and personnel management competences. The department implements these training objective
	teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students ca
	by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two
	catalogues for nontechnical complementary courses. The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic profollow 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 orientation knowledge in the form of "profiles".
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the objects.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisc and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication studies, studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's countable 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 commuskills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Ba

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,
- different specialist disciplines relate to their own discipline and differentiate it as well as make connections,
- sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,
- Can communicate in a foreign language in a manner appropriate to the subject.

Skills Professional Competence (Skills)

In selected sub-areas students can

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

Personal Competence

Social Competence

Personal Competences (Social Skills)

Students will be able

- to learn to collaborate in different manner,
- to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,



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

Courses

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



Courses Title Typ Hrswk Nonlinear Structural Analysis (L0277) Nonlinear Structural Analysis (L0279) Rectation Section (small) Module Responsible Admission Requirements None Recommended Previous Knowledge Differential Equations 2 (Partial Differential Equations) Educational Objectives Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and medical parts 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 structures to new problems.	CP 4					
Title						
Nonlinear Structural Analysis (L0277) Nonlinear Structural Analysis (L0279) Module Responsible Prof. Alexander Düster Admission Requirements None Recommended Previous Knowledge Differential Equations 2 (Partial Differential Equations) Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and median structural problems. + select for a given nonlinear structural problems a suitable computational procedure. + apply finite element procedures for nonlinear structural analysis. + critically verify and judge results of nonlinear solution procedures to new problems.						
Nonlinear Structural Analysis (L0279) Recitation Section (small) Module Responsible Admission Requirements Recommended Previous Knowledge Differential Equations 2 (Partial Differential Equations) Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and median model of a given 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 structural analysis. + to transfer their knowledge of nonlinear solution procedures to new problems.						
Module Responsible Prof. Alexander Düster Admission Requirements None Recommended Previous Knowledge Differential Equations 2 (Partial Differential Equations) Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and med skills Skills Students are able to + 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 solution procedures to new problems.	•					
Admission Requirements Recommended Previous Knowledge Mathematics I, II, III, Mechanics I, II, III, IV Differential Equations 2 (Partial Differential Equations) After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and med Skills Students are able to + 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.	2					
Recommended Previous Knowledge Differential Equations 2 (Partial Differential Equations) Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and medical skills Students are able to + 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.						
Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and medical models. Skills Students are able to + 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 solution procedures to new problems.						
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+ critically verify and judge results of nonlinear finite elements. + to transfer their knowledge of nonlinear solution procedures to new problems.						
+ to transfer their knowledge of nonlinear solution procedures to new problems.						
Personal Competence						
Social Competence Students are able to						
	+ solve problems in heterogeneous groups and to document the corresponding results.					
+ share new knowledge with group members.						
	T andie nem knomedye with group members.					
Autonomy Students are able to	Students are able to					
+ assess their knowledge by means of exercises and E-Learning.						
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: Elective Compulsory						
Curricula International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory						
Materials Science: Specialisation Modelling: Elective Compulsory						
Mechatronics: Specialisation System Design: Elective Compulsory						
Product Development, Materials and Production: Core qualification: Elective Compulsory						
Naval Architecture and Ocean Engineering: Core qualification: Elective Compulsory						
Ship and Offshore Technology: Core qualification: Elective Compulsory						
Theoretical Mechanical Engineering: Core qualification: Elective Compulsory						
Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory						

Course L0277: Nonlinear Structural Analysis				
	Lecture			
Hrs/wk				
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			
	. 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 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	



Module M0742: Thermal En	gineering			
				
Courses				
Title		Тур	Hrs/wk	CP
Thermal Engineering (L0023)		Lecture	3	5
Thermal Engineering (L0024)		Recitation Section (large)	1	1
Module Responsible	Prof. Gerhard Schmitz			
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 results		
Professional Competence				
Knowledge	Students know the different energy conversion stages and the dif	·		-
	heat and mass transfer, especially in regard to buildings and mobi			
	relevant rules. They know to differ different heating systems in the			
	to model a furnace and to calculate the transient temperatures in a burners and how to conduct the flue gases into the atmosphere. T			
	burners and now to conduct the flue gases into the atmosphere. I	ney are able to model thermodynamic sy	sterns with object one	enteu languages.
Ckillo	Students are able to calculate the heating demand for different h	eating avetame and to shoop the avital	ala aampananta Tha	v ara abla ta aalaulata a
Skills	Students are able to calculate the heating demand for different h	* *	·	•
	pipeline network and have the ability to perform simple planning tasks, regarding solar energy. They can write Modelica programs and can transfer research knowledge into practice. They are able to perform scientific work in the field of thermal engineering.			
	research knowledge into practice. They are able to perform scienti	ic work in the field of thermal engineering	y.	
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an approach.			
Coolai Competence	The stadents are able to discuss in small groups and develop and	pprodon.		
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess Er	ngineering: Flective Compulsory		
Curricula	Energy and Environmental Engineering: Specialisation Energy En			
Junicula	Energy Systems: Specialisation Energy Systems: Compulsory	gg. Eloonto Compulsory		
	Energy Systems: Specialisation Marine Engineering: Elective Com	pulsory		
	International Management and Engineering: Specialisation II. Ene		tive Compulsory	
	Product Development, Materials and Production: Core qualification	• •	, ,	
	Renewable Energies: Core qualification: Compulsory	. ,		
	Theoretical Mechanical Engineering: Specialisation Energy System	ns: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		
	Process Engineering: Specialisation Process Engineering: Elective	e Compulsory		

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
Literature	 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 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 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 Laws and standards 5.1 Buildings 5.2 Industrial plants
Literature	 Schmitz, G.: Klimaanlagen, Skript zur Vorlesung VDI Wärmeatlas, 11. Auflage, Springer Verlag, Düsseldorf 2013 Herwig, H.; Moschallski, A.: Wärmeübertragung, Vieweg+Teubner Verlag, Wiesbaden 2009 Recknagel, H.; Sprenger, E.; Schrammek, ER.: Taschenbuch für Heizung- und Klimatechnik 2013/2014, 76. Auflage, Deutscher Industrieverlag, 2013



Course 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	Calculus					
Knowledge	Linear Algebra					
	Engineering Mechanics					
	2.igoring Moonanios					
Educational Objectives	After taking part successfully, students have reached the following	wing learning results				
Professional Competence						
Knowledge	Students are able to denote terms and concepts of Vibration	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 groups.					
Autonomy	Students are able to approach individually research tasks in Vibration Theory.					
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	Energy Systems: Core qualification: Elective Compulsory					
Curricula	Computational Science and Engineering: Specialisation Science	entific Computing: Elective Compulsory				
	International Management and Engineering: Specialisation I	I. Mechatronics: Elective Compulsory				
	Biomedical Engineering: Specialisation Artificial Organs and	Regenerative Medicine: Elective Comp	ulsory			
	Biomedical Engineering: Specialisation Implants and Endop	rostheses: Elective Compulsory				
	Biomedical Engineering: Specialisation Medical Technology		•			
	Biomedical Engineering: Specialisation Management and Bu		sory			
	Product Development, Materials and Production: Core qualif					
	Naval Architecture and Ocean Engineering: Core qualificatio					
	Theoretical Mechanical Engineering: Core qualification: Elec					
1	Theoretical Mechanical Engineering: Technical Complemen	tary 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	СР
Finite Element Methods (L0291)		ture	2	3
Finite Element Methods (L0804)		citation 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, Kir	nematics, Dynamics)		
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the following learning resul	ılts		
Professional Competence	,			
Knowledge	The students possess an in-depth knowledge regarding the derivation of the fil	nite element method and are able	to give an overvie	ew of the theoretical
	and methodical basis of the method.			
Skills	The students are capable to handle engineering problems by formulating suita solving the resulting system of equations.	able finite elements, assembling th	e corresponding s	ystem matrices, and
Personal Competence Social Competence Autonomy	- The students are able to independently solve challenging computational proble and the results are critically scrutinized.	ems and develop own finite eleme	nt routines. Probler	ns can be identifiec
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: Core qualification: Compulsory			
Curricula	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsi	sory		
	Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective	re Compulsory		
	Computational Science and Engineering: Specialisation Scientific Computing: E	Elective Compulsory		
	International Management and Engineering: Specialisation II. Mechatronics: Ele	ective Compulsory		
	International Management and Engineering: Specialisation II. Product Developm	ment and Production: Elective Com	pulsory	
	Mechatronics: Core qualification: Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medi	licine: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Compuls	sory		
	Biomedical Engineering: Specialisation Medical Technology and Control Theory	y: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Business Administrati	ion: Elective Compulsory		
	Product Development, Materials and Production: Core qualification: Compulsory	у		
	Technomathematics: Specialisation III. Engineering Science: Elective Compulso			
	Technomathematics: Core qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Core qualification: Compulsory			



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 Metho	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	57)	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 follo	wing learning results		
Professional Competence				
Knowledge	Students can explain how linear dynamic systems are	e represented as state space models: they can	n interpret the system	response to initial state
	or external excitation as trajectories in state space	o represented as state space moders, they sai	Time protine system	response to initial state
	They can explain the system properties controllability	and observability, and their relationship to sta	te feedback and state	e estimation, respectively
	They can explain the significance of a minimal realisa			, , , , , , , , , , , , , , , , , , , ,
	They can explain observer-based state feedback and		sturbance rejection	
	They can extend all of the above to multi-input multi-o			
	They can explain the z-transform and its relationship v	with the Laplace Transform		
	They can explain state space models and transfer fun	ction models of discrete-time systems		
	They can explain the experimental identification of AF	RX models of dynamic systems, and how the i	dentification problem	can be solved by solving
	a normal equation			
	They can explain how a state space model can be con	nstructed from a discrete-time impulse respon	se	
Skills	Ot death and the office the office of the discount of the original of the orig	total and a second day and day are		
	Students can transform transfer function models into s	•		
	They can assess controllability and observability and They can design I OC controllars for multiplication to a larger than the second to the second			
	They can design LQG controllers for multivariable pla They can carry out a controller design both in contini		ido which is appropr	iata for a given camplin
	rate	dous-line and discrete-line domain, and dec	ide willcir is appropr	iate for a given sampling
	They can identify transfer function models and state specified.	pace models of dynamic systems from experir	nental data	
	They can carry out all these tasks using standard softs			Simulink)
Personal Competence				
Social Competence	Students can work in small groups on specific problems to an	rive at joint solutions.		
Autonomy	Students can obtain information from provided sources (le	cture notes, software documentation, experi	ment guides) and us	se it when solving give
	problems.			
	The second of the state of the	the color of the telephone to the color		
	They can assess their knowledge in weekly on-line tests and	thereby control their learning progress.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Computer Science: Specialisation Intelligence Engineering: 8	Elective Compulsory		
Curricula	Electrical Engineering: Core qualification: Compulsory	y		
Ourricula	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems	: Compulsory		
	Computational Science and Engineering: Specialisation Syst	' '	pulsory	
	International Management and Engineering: Specialisation II	0 0	ry	
	International Management and Engineering: Specialisation II			
	Mechanical Engineering and Management: Specialisation Me			
	Mechatronics: Core qualification: Compulsory	•		
	Biomedical Engineering: Specialisation Artificial Organs and	Regenerative Medicine: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants and Endopr			
	Biomedical Engineering: Specialisation Medical Technology			
	* * * * * * * * * * * * * * * * * * * *			
	Biomedical Engineering: Specialisation Management and Bu	isiness Administration: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Bu Product Development, Materials and Production: Core qualifi			



Course L0656: Control Systems The	eory and Design
	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN 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
I itawa tuwa	
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
	L

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



Module M1150: Continuum	Mechanics			
Courses				
Title		Тур	Hrs/wk	СР
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	ng learning results		
Professional Competence				
Knowledge				
	The students can explain the fundamental concepts to calculate	the mechanical behavior of materials.		
Skills	The students can set up balance laws and apply basics of defor	nation theory to specific aspects, both in ap	plied contexts as in r	esearch contexts.
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to c	evelop ideas further.		
Autonomy	The students are able to assess their own strengths and weakne	esses and to define tasks themselves. They	can solve exercises	in the area of continuum
riaterionly	mechanics on their own.	social to define tasks themselves. They	dan dorve exercises	in the died of continuum
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 Scienti	iic Computing: Flective Compulsory		
Curricula	Materials Science: Specialisation Modelling: Elective Compulso			
Garriodia	Mechanical Engineering and Management: Specialisation Mate			
	Mechatronics: Technical Complementary Course: Elective Comp			
	Biomedical Engineering: Specialisation Artificial Organs and Re	•		
	Biomedical Engineering: Specialisation Implants and Endoprosi			
	Biomedical Engineering: Specialisation Medical Technology an			
	Biomedical Engineering: Specialisation Management and Busin			
	Product Development, Materials and Production: Core qualificat			
	Theoretical Mechanical Engineering: Core qualification: Elective			
	Theoretical Mechanical Engineering: Technical Complementary	• •		

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, Dr. Songyun Ma	
Language	DE/EN	
Cycle	WiSe	
Content	kinematics of undeformed and deformed bodies balance equations (balance of mass, balance of energy,) stress states material modelling	
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer	



Course L1534: Continuum Mechanics 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	 kinematics of undeformed and deformed bodies balance equations (balance of mass, balance of energy,) stress states material modelling 	
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer	



Module M1151: Material Mo	doling			
Module Wil 151: Material Mo	deling			
Courses				
Title		Тур	Hrs/wk	СР
Material Modeling (L1535)		Lecture	2	3
Material Modeling (L1536)		Recitation Section (sm	all) 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 reached the	ne following learning results		
Professional Competence				
Knowledge	The students can explain the fundamentals of multidim	ensional consitutive material laws		
Skills	The students can implement their own material laws in	n finite element codes. In particular, the stu	idents can apply their knowled	dge to various problems of
	material science and evaluate the corresponding material	rial models.		
Personal Competence				
Social Competence	The students are able to develop solutions, to present	them to specialists and to develop ideas fu	ırther.	
Autonomy	The students are able to assess their own strengths ar	nd weaknesses and to define tasks themse	alves. They can solve exercise	s in the area of continuum
nationismy	mechanics on their own.	a weakinesses and to define tasks themse	sives. They dan solve excrosse	5 III tile area or continuum
	Independent Study Time 124, Study Time in Lecture 56	5		
	6			
Examination	Oral exam			
	30 min			
Assignment for the Following	Computational Science and Engineering: Specialisation		ory	
Curricula	Materials Science: Specialisation Modelling: Elective C	• •		
	Mechanical Engineering and Management: Specialisa			
	Biomedical Engineering: Specialisation Artificial Organ	-	ompulsory	
	Biomedical Engineering: Specialisation Implants and I			
	Biomedical Engineering: Specialisation Medical Techn		•	
	Biomedical Engineering: Specialisation Management		npulsory	
	Product Development, Materials and Production: Core			
	Theoretical Mechanical Engineering: Specialisation M			
	Theoretical Mechanical Engineering: Technical Comp	ementary Course: 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, Dr. Dirk Steglich
Language	DE/EN
Cycle	WiSe
Content	fundamentals of finite element methods fundamentals of material modeling introduction to numerical implementation of material laws overview of modelling of different classes of materials combination of macroscopic quantities to material microstructure
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, Dr. Ingo Scheider
Language	DE/EN
Cycle	WiSe
Content	
	fundamentals of finite element methods fundamentals of material modeling introduction to numerical implementation of material laws overview of modelling of different classes of materials combination of macroscopic quantities to material microstructure
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



Module M1173: Applied Sta	atistics			
Courses				
Title		Тур	Hrs/wk	СР
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 followi	ng 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			
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: Specialisation Man	agement: Elective Compulsory		
Curricula	Mechatronics: Specialisation System Design: Elective Compuls	ory		
	Mechatronics: Specialisation Intelligent Systems and Robotics:	Elective Compulsory		
	Biomedical Engineering: Core qualification: Compulsory			
	Product Development, Materials and Production: Core qualifica	tion: Elective Compulsory		

Course L1584: Applied Statistics			
Тур	Lecture		
Hrs/wk	2		
CP			
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, 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
Content	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).
	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



Module M1204: Modelling a	and Optimization in Dynamics			
Courses				
Title		Тур	Hrs/wk	CP
Flexible Multibody Systems (L1632) Optimization of dynamical systems (L1633)	2)	Lecture Lecture	2	3
	Prof. Robert Seifried	Lecture	2	3
Module Responsible	None			
Admission Requirements Recommended Previous	Notice			
Knowledge	Mathematics I, II, III			
Kilowieuge	Mechanics I, II, III, IV			
	Simulation of dynamical Systems			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	Students demonstrate basic knowledge and understa	anding of modeling, simulation and analysis	of complex rigid and flexible	e multibody systems and
	methods for optimizing dynamic systems after success	ful completion of the module.		
Skills	Students are able			
	+ to think holistically			
	+ to independently, securly and critically analyze and	optimize basic problems of the dynamics of rig	id and flexible multibody sys	stems
	+ to describe dynamics problems mathematically			
	+ to optimize dynamics problems			
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups and to do	cument the corresponding results.		
Autonomy	Students are able to			
	+ assess their knowledge by means of exercises.			
	+ acquaint themselves with the necessary knowledge	to solve research oriented tasks.		
	, and the most of			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Energy Systems: Core qualification: Elective Compuls	ory		
Curricula	Aircraft Systems Engineering: Specialisation Aircraft S			
	Mechatronics: Specialisation System Design: Elective	Compulsory		
	Mechatronics: Specialisation Intelligent Systems and	Robotics: Elective Compulsory		
	Product Development, Materials and Production: Core	qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification	n: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Comp	lementary Course: Elective Compulsory		

Course L1632: Flexible Multibody Systems			
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	1. Basics of Multibody Systems 2. Basics of Continuum Mechanics 3. Linear finite element modelles and modell reduction 4. Nonlinear finite element Modelles: absolute nodal coordinate formulation 5. Kinematics of an elastic body 6. Kinetics of an elastic body 7. System assembly		
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 dynamical systems		
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	1. Formulation and classification of optimization problems 2. Scalar Optimization 3. Sensitivity Analysis 4. Unconstrained Parameter Optimization 5. Constrained Parameter Optimization 6. Stochastic optimization 7. Multicriteria Optimization 8. Topology Optimization	
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	FFM			
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Courses				
Title		Тур	Hrs/wk	СР
High-Order FEM (L0280)		Lecture	3	4
High-Order FEM (L0281)		Recitation Section (large)	1	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	following learning results		
Professional Competence				
Knowledge	Students are able to			
	+ give an overview of the different (h, p, hp) finite elemen	t procedures.		
	+ explain high-order finite element procedures.			
	+ specify problems of finite element procedures, to identi	fy them in a given situation and to explain their m	athematical and mech	anical background.
Cl.:IIa	Students are able to			
Skills		ral maghanias		
	+ apply high-order finite elements to problems of structur			
	+ 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	o new problems.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups and to docume	nent the corresponding results.		
Autonomy	Studente ere oble to			
Autonomy	Students are able to + assess their knowledge by means of exercises and E-L			
		•		
	+ acquaint themselves with the necessary knowledge to	solve research offented 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	Computational Science and Engineering: Specialisation	Scientific Computing: Elective Compulsory		
	Materials Science: Specialisation Modelling: Elective Co	mpulsory		
	Mechanical Engineering and Management: Specialisation	on Product Development and Production: Elective	Compulsory	
	Mechatronics: Technical Complementary Course: Elective	ve Compulsory		
	Product Development, Materials and Production: Core qu	ualification: Elective Compulsory		
	Naval Architecture and Ocean Engineering: Core qualific	cation: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification:	Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Compler	mentary Course: Flective Compulsory		

Lecture			
3			
4			
Independent Study Time 78, Study Time in Lecture 42			
Prof. Alexander Düster			
EN			
SoSe			
1. Introduction			
2. Motivation			
Hierarchic shape functions			
. Mapping functions			
Computation of element matrices, assembly, constraint enforcement and solution			
Convergence characteristics			
Mechanical models and finite elements for thin-walled structures			
Computation of thin-walled structures			
. Error estimation and hp-adaptivity			
10. High-order fictitious domain methods			
[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		
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 Prote	ection Psycho Acquistics)		
module moods. resimilar /	100000000 1 (40000000 110000, 110000 11000	otion, i Syono Acoustics /		
Courses				
Title		Тур	Hrs/wk	СР
Technical Acoustics I (Acoustic Waves, N	oise Protection, Psycho Acoustics) (L0516)	Lecture	2	3
Technical Acoustics I (Acoustic Waves, N	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 Mech	nanics II (Hydrostatics, Kinematics, Dynamics)		
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge in acou	stics regarding acoustic waves, noise protection,	and psycho acoustics	and are able to give a
	overview of the corresponding theoretical and methodic	cal basis.		
Skills	The students are capable to handle engineering proble	ome in acquetice by theory based application of th	o domandina mothodo	logics and massuramor
Okins	procedures treated within the module.	sins in accusing by theory-based application of th	e demanding methodo	logies and measuremen
	procedures acques warm are modern.			
Personal Competence				
Social Competence				
Autonomy	The students are able to independently solve challeng	ging acoustical problems in the areas treated wit	nin the module. Possib	le conflicting issues an
	limitations can be identified and the results are critically	scrutinized.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	1		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following	Energy Systems: Core qualification: Elective Compulso	ry		
Curricula	Aircraft Systems Engineering: Specialisation Cabin Sys	stems: Elective Compulsory		
	International Management and Engineering: Specialisa	ation II. Aviation Systems: Elective Compulsory		
	Mechatronics: Specialisation System Design: Elective 0	Compulsory		
	Product Development, Materials and Production: Core	qualification: Elective Compulsory		
	Technomathematics: Core qualification: Elective Comp	ulsory		
	Technomathematics: Specialisation III. Engineering Sci	ience: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Pro	oduct Development and Production: Elective Com	oulsory	
	Theoretical Mechanical Engineering: Technical Comple	ementary Course: Elective Compulsory		

Course L0516: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics)		
Тур	Lecture	
Hrs/wk	2	
СР	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	
Litaratura	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin	
Literature		
	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		Tun	Hrs/wk	CP
Boundary Element Methods (L0523)		Typ Lecture	Hrs/wk	3
Boundary Element Methods (L0524)		Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	none			
Recommended Previous	Mechanics I (Statics, Mechanics of Materials) and Mechanics	s II (Hydrostatics, Kinematics, Dynamics)		
Knowledge	Mathematics I, II, III (in particular differential equations)	(,,		
	, , ,			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge regarding t	he derivation of the boundary element meth	od 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 to	ov formulating suitable boundary elements, as	sembling the corresi	oonding system matrices
	and solving the resulting system of equations.	,,,,,,,		g -,
Personal Competence				
Social Competence	-			
Autonomy	The students are able to independently solve challenging computational problems and develop own boundary element routines. 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: Ele	ctive Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Coastal Engineering: Elect	ve Compulsory		
	Energy Systems: Core qualification: Elective Compulsory			
	Computational Science and Engineering: Specialisation Science	entific Computing: Elective Compulsory		
	Mechanical Engineering and Management: Specialisation P	roduct Development and Production: Elective	Compulsory	
	Mechatronics: Specialisation System Design: Elective Comp	ulsory		
	Product Development, Materials and Production: Core qualif	ication: Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Science			
	Technomathematics: Core qualification: Elective Compulsor			
	Theoretical Mechanical Engineering: Core qualification: Elec			
	Theoretical Mechanical Engineering: Technical Complemen	tary Course: Elective Compulsory		

Course L0523: Boundary Element N	Course L0523: Boundary 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	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	



Module M1164: Practical C	ourse Product Development, Materi	als and Production	
ourses			
		Tim	Heateste OD
tle	Interiols and Production (I 1566)	Typ	Hrs/wk CP
ractical Course Product Development, N		Laboratory	0 0
Module Responsible	Prof. Wolfgang Hintze		
Admission Requirements	none		
Recommended Previous Knowledge	Product Development:		
Knowleage	Lectures: Mechanics I-III		
	 Lectures: Integrated Product Developme 	nt I incl. CAD practical training	
	Materials:		
	Locturos: Structural Motallia Materiala M	etallic Materials for Aircraft Applications, Introduction	to Materials Testing
		ymers, Structure and Properties of Composites, Manu	
	Lectures. Officiale and Properties of For	ymers, outdoute and ritoperites of composites, manu	diactuming of Folymers and Composites
	Production:		
	Lecture: Production Engineering		
	Lectures: Forming and Cutting Technology	av. Methods of production process design	
	Lectures: Machine Tools and Robotic	g,,g	
Educational Objectives	After taking part successfully, students have read	ched the following learning results	
Professional Competence			
Knowledge	Students can		
•			
	represent more complex context of difference of the context of the context of difference of the context of the context of difference of the context of the		
	describe functionality of modern measure	ement instrumentations and machine technologies.	
Skilla	Students are capable of		
SKIIIS	Students are capable of		
	 applying theoretical knowledge for practi 	cal applications.	
	 applying provided experimental methods 	for examining contexts of different fields of study.	
	 analyzing and evaluating experimental re 		
	applying modern measurement instrume	ntations.	
Personal Competence			
Social Competence	Students can		
	carry out and document experimental wo	rk in groups.	
	 present and discuss experimental results 	in mixed teams of different fields of study.	
Autonomy	Students are able to		
	carry out parts of experimental work inde	nendently guided by teachers	
	 carry out parts of experimental work inde choose and apply suitable instruments. 	pondonay galada by loadilois.	
	assess own strengths and weaknesses.		
	and the state of t		
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ıre 84	
Credit points	6		
Examination	Written elaboration		
Examination duration and scale			
Assignment for the Following	Biomedical Engineering: Core qualification: Cor	nnulsorv	
Curricula	Product Development, Materials and Production		
Curricula		. 55.5 quaniouson. Compulsory	



Course L1566: Practical Course Product Development, Materials and Production		
Тур	Laboratory	
Hrs/wk	6	
СР	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 D	Dynamics			
•				
Courses				
Title		Тур	Hrs/wk	CP
Nonlinear Dynamics (L0702)		Lecture	4	6
Module Responsible	Prof. Norbert Hoffmann			
Admission Requirements	None			
Recommended Previous	Calculus			
Knowledge	Linear Algebra			
	Engineering Mechanics			
	Ling. Tooling Modification			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
Knowledge	Students are able to reflect existing terms and concepts in Nonlin	ear Dynamics and to develop and	research new terms and conce	epts.
Skills	Students are able to apply existing methods and procesures of N	onlinear Dynamics and to develop	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	and 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	ective Compulsory		
Curricula	Computational Science and Engineering: Specialisation Scientifi	Computing: Elective Compulsor	/	
	International Management and Engineering: Specialisation II. Me	chatronics: Elective Compulsory		
	Mechanical Engineering and Management: Specialisation Mech	atronics: Elective Compulsory		
	Mechatronics: Specialisation System Design: Elective Compulso	у		
	Mechatronics: Specialisation Intelligent Systems and Robotics: E	ective Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs and Reg	enerative Medicine: Elective Com	pulsory	
	Biomedical Engineering: Specialisation Implants and Endoprost	eses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology and	Control Theory: Elective Compuls	sory	
	Biomedical Engineering: Specialisation Management and Busin	ess Administration: Elective Comp	ulsory	
	Product Development, Materials and Production: Core qualificati	on: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification: Elective			
1	Theoretical Mechanical Engineering: Technical Complementary	Course: 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.



Module M0806: Technical	Acoustics II (Room Acoustics, Comp	outational Methods)		
Courses				
Title		Тур	Hrs/wk	СР
Technical Acoustics II (Room Acoustics,	Computational Methods) (L0519)	Lecture	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 Pro	otection, Psycho Acoustics)		
Knowledge	,			
	Mechanics I (Statics, Mechanics of Materials) and	d Mechanics II (Hydrostatics, Kinematics, Dynamics)		
	Mathematics I, II, III (in particular differential equa	tions)		
		<u> </u>		
Educational Objectives	After taking part successfully, students have reached the following 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 and			
	procedures treated within the module.			
	•			
Personal Competence				
Social Competence				
Autonomy				
	limitations can be identified and the results are cr	ritically scrutinized.		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Cab	oin Systems: Elective Compulsory		
Curricula				
	Product Development, Materials and Production:	Core qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisati	ion Product Development and Production: Elective Co	mpulsory	
	Theoretical Mechanical Engineering: Technical C	Complementary Course: Elective Compulsory		

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)	
Literature	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin	
Enterature	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	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	



Module M1140: Technical Complementary Course Core Studies for PEPMS (according to Subject Specific Regulations)						
Courses						
ïtle	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	See selected module according to FSPO					
Assignment for the Following	Product Development, Materials and Production: Core qualification: Elective Compulsory					
Curricula						



Module M1184: Research 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	 Students can explain the project as well as their autonomously gained knowledge and relate it to current issues of their field of study. They can explain the basic scientific methods they have worked with. 					
Skills	The students are able to autonomously solve a limited scientific task under the guidance of an experienced researcher. They can justify and explain thei approach for problem solving; they can draw conclusions from their results, and then can find new ways and methods for their work. Students are 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 high-performance 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 Systems 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	Mathagas Car					
	Mathematics Machanian					
	MechanicsThermodynamics					
	*					
	Electrical EngineeringHydraulics					
	Control Systems					
	• Control Systems					
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results				
Professional Competence						
Knowledge	Students are able to:					
	Describe essential components and design points or	f hydraulic, electrical and high-lift systems				
	Give an overview of the functionality of air conditionin					
	Explain the need for high-lift systems such as ist fund					
	Assess the challenge during the design of supply systems.					
Skills	Students are able to:					
	 Design hydraulic and electric supply systems of aircr 	rafts				
	Design high-lift systems of aircrafts					
	Analyze the thermodynamic behaviour of air conditions	oning systems				
	,					
Personal Competence						
Social Competence	Students are able to:					
Coolai Compositio	Cladella are able to.					
	 Perform system design in groups and present and di 	scuss results				
Autonomy	Students are able to:					
	Reflect the contents of lectures autonomously					
	Independent Study Time 110, Study Time in Lecture 70					
Examination duration and scale	Written exam 165 Minutes					
Examination duration and scale	165 Minutes	ompulaen,				
Assignment for the Following	Energy Systems: Specialisation Energy Systems: Elective C					
Curricula	Aircraft Systems Engineering: Core qualification: Compulsor					
	International Management and Engineering: Specialisation					
	Product Development, Materials and Production: Specialisa		у			
	Product Development, Materials and Production: Specialisa					
	Product Development, Materials and Production: Specialisa	• •				
	Theoretical Mechanical Engineering: Specialisation Aircraft					
	Theoretical Mechanical Engineering: Technical Complement	nary 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	 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) Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
Literature	 Moir, Seabridge: Aircraft Systems Green: Aircraft Hydraulic Systems Torenbek: Synthesis of Subsonic Airplane Design SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

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 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	learning results		
Professional Competence				
Knowledge	After passing the module students are able to:			
	 explain technical terms of design methodology, 			
	 describe essential elements of construction management, 			
	describe current problems and the current state of research	h of integrated product development		
	- describe durient problems and the durient state director	n or integrated product development.		
Skills	After passing the module students are able to:			
	 select and apply proper construction methods for non-stan 	dardized solutions of problems as well	as adapt new boundary	conditions,
	solve product development problems with the assistance of		,	,
	 choose and execute appropriate moderation techniques. 	,		
	a contract of the change of th			
Personal Competence				
Social Competence	After passing the module students are able to:			
	prepare and lead team meetings and moderation process.	98,		
	 work in teams on complex tasks, 			
	represent problems and solutions and advance ideas.			
Autonomy	After passing the module students are able to:			
	 give a structured feedback and accept a critical feedback, implement the accepted feedback autonomous. 			
	implement the accepted leedback 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: Elec	tive Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation Sy	stems: Elective Compulsory		
	International Management and Engineering: Specialisation II. Pro	duct Development and Production: Elec	ctive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsor	y		
	Product Development, Materials and Production: Specialisation P	roduct Development: Compulsory		
	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	laterials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Deve	elopment and Production: Elective Com	pulsory	
	Theoretical Mechanical Engineering: Technical Complementary (Course: Elective Compulsory		



Course L1254: Integrated Product D	Development 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
	 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 management 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	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.
	 Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.
	Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.
	 Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007.
	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.
	Composition of the state of the

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				
Title		Тур	Hrs/wk	СР
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Problem-based Learning	1	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, hydrostatic	cs, kinematics and kinetics), fluid m	echanics, and enginee	ring design
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learn	ning results		
Professional Competence				
Knowledge	After passing the module students are able to			
	explain structures and functionalities of hydrostatic, pneumatic,			
	explain the interaction of hydraulic components in hydraulic sys	items,		
	explain open and closed loop control of hydraulic systems,			
	 describe functioning and applications of hydrodynamic torque plant technology 	converters, brakes and clutches a	is well as centritugal p	umps and aggregates in
Skills	After passing the module students are able to			
	analyse and assess hydraulic and pneumatic components and			
	design and dimension hydraulic systems for mechanical applications			
	 perform numerical simulations of hydraulic systems based on abstract problem definitions, 			
	select and adapt pump characteristic curves for hydraulic systems			
	dimension hydrodynamic torque converters and brakes for mec	hanical aggregates.		
Personal Competence				
Social Competence				
	discuss and present functional context in groups,			
	organise teamwork autonomously.			
Autonomy	After passing the module students are able to			
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	International Management and Engineering: Specialisation II. Mechatro	onics: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory			
	Product Development, Materials and Production: Specialisation Produc	ct Development: Compulsory		
	Product Development, Materials and Production: Specialisation Produc	ction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materia	als: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Developm	nent and Production: Elective Comp	oulsory	
		e: Elective Compulsory	-	



Course 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
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
	Latitise
	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
	Tomonous omercular or nyurous and operation
	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
	(partly) self-organised teamwork
Literature	Bücher
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006
	Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006 Reite W. Crate K. H. Dubbal, Teubanburb fürden Machbinanbar, Caringan Vaden, Redia albumla Auflage.
	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



ourses				
itle		Тур	Hrs/wk	CP
omputer and communication technology	in cabin electronics and avionics (L1557)	Lecture	2	2
	in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
odel-Based Systems Engineering (MBSI	E) with SysML/UML (L1551)	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			
	Province knowledge in:			
	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:			
	describe the structure and operation of computer architectures			
	• explain the structure and operation of digital communication N	etworks		
	• explain architectures of cabin electronics, integrated modular	avionics (IMA) and Aircraft Data Communica	ation Network (ADCN)
	• understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems			ystems
Skills				
	understand, operate and maintain a Minicomputer			
	build up a network communication and communicate with other			
	connect a minicomputer with a cabin management system (A3)			
	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	ete solution		
Autonomy	Students are able to:			
	organize and schedule their practical tasks			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
	Aircraft Systems Engineering: Specialisation Aircraft Systems: E	lective Compulsory		
Assignment for the Following Curricula				
Gurricula	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 Product Development, Materials and Production: Specialisation		у	
	i roduct Development, iviaterials and Froduction. Specialisation	r roduction. Liective Compuisory		



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
СР	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	- 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 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	
<u> </u>		



Module M0511: Electricity (Generation from Wind and Hydro Power			
Courses				
Title		Тур	Hrs/wk	CP
Renewable Energy Projects in Emerged Markets (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 follow	ving learning results		
Professional Competence	**			
Knowledge				
	Through active discussions of various topics within the se theoretical background and are thus able to transfer what they		their understanding an	d the application of th
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 mu	Itidisciplinary 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	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E			
	Civil Engineering: Specialisation Coastal Engineering: Electiv	e Compulsory		
	Energy and Environmental Engineering: Specialisation Energ	y Engineering: Elective Compulsory		
	International Management and Engineering: Specialisation II.	Renewable Energy: Elective Compulsor	y	
	International Management and Engineering: Specialisation II.	Energy and Environmental Engineering:	Elective Compulsory	
	Product Development, Materials and Production: Specialisation	on Product Development: Elective Compu	ılsory	
	Product Development, Materials and Production: Specialisation	on Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	on Materials: Elective Compulsory		
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process E	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environ	iment: Compulsory		
	Water and Environmental Engineering: Specialisation Cities: I	Elective Compulsory		



Course L0014: Renewable Energy Projects in Emerged Markets		
Тур	Project Seminar	
Hrs/wk		
CP		
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	
	■ History	
	Future markets	
	Special challenges in new markets - Overview	
	Sample project wind farm Korea	
	• Survey	
	Technical Description	
	Project phases and characteristics	
	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	 Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice
Literature	 Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006



Course L0011: Wind Turbine Plants		
Тур	ecture	
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	Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion	
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005	

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



Iodule M0996: Supply Cha				
ourses				
itle		Тур	Hrs/wk	СР
upply Chain Management (L1218)		Problem-based Learning	3	4
alue-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	no			
December ded Drevieus				
Recommended Previous Knowledge	no			
Educational Objectives	After taking part augeografully at idente have reached the following loss	ning roculto		
•	After taking part successfully, students have reached the following lear	ning results		
Professional Competence				
Knowledge	Current developments in international business activities such as out	sourcing, offshoring, internationaliza	ition and globalizatio	n and emerging mar
	illustrated by examples from practice. Theoretical Approaches and methods in logistics and supply chain m	anagement and use in practice		
	to identify fields of decision in SCM.	anagement and use in practice.		
	reasons for the formation of networks based on various theories fron	institutional economics (transaction	cost theory principa	al-agent theory prope
	right theory) and the resource-based view.		. coot arcory, principe	ar agont arooty, prop
	Selected approaches to explain the development of networks.			
	• to illustrate phases of network formation.			
	• to understand the functional mechanisms of inter-organizational and	international network relationships.		
	• to explain and categorize relationships within networks.			
	• to categorize sourcing concepts and explain motives/ barriers or adva	intages 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 location	decisions at the global level (total ne	etwork costs).	
	• to explain methods for location finding/evaluation.			
	to interpret phenotypes of production networks.			
	• recognize relationships between R & D and production and their loca	tions and to describe coherent mode	ls.	
	• to solve sub-problems with the configuration of logistics networks (dis	tribution and spare parts networks) I	by the use of appropr	iate approaches.
	• to categorise special waste logistics including their duties & objective	s and to state and describe practical	examples of good ne	tworking.
Skills	• to asses trends and challenges in national and international supply of	hains and logistics networks and the	ir consequences for c	companies.
Onmo	 to asses trends and challenges in national and international supply chains and logistics networks and their consequences for compar to evaluate, analyse and systematise networks and network relations based on the lecture. 		ompanios.	
	to anaylse partners and their suitability for co-operation in collaboration.			
	to select sourcing concepts for specific products / product compositions	·	as advantages and	I disadvantages of e
	approach.			
	• to evaluate location decisions for production and R & D based on cor	cepts.		
	• 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 analyse concepts of Information and communication management	in logistics.		
	• to design subcontracting, procurement, production and disposal as w	ell 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 disc	ussed case studies		
occiai competence	advance planning and design of network formation and their objective.		e lecture.	
	definition of procurement strategies for individual parts using the gain			
	design of the procurement network (external/internal/modules etc.) b			as well as on the find
	of the case studies.	J		
	to make decision of location for production taking into account global	obal contexts, evaluation methods a	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 from case	studies / practical examples and the	selection of an approp	priate model.
Autonomy	After completing the module students are capable to work indepen	dently on the subject of Supply Cl	nain Management ai	nd transfer the acqu
	knowledge to new problems.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination				
Examination duration and scale	120 min			
Assignment for the Following	International Management and Engineering: Specialisation I. Electives	Management: Elective Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Specialisation Production and Lo			
Curricula	Product Development, Materials and Production: Specialisation Production Prod		v	
	Product Development, Materials and Production: Specialisation Production: Production: Specialisation Production: Production: Specialisation Production		,	
	Product Development, Materials and Production: Specialisation Materials			



ourse L1218: Supply Chain Manage	ement
Тур	Problem-based Learning
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	SoSe
Content	 Transmission of a profound understanding in logistics and supply chain management Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts to business cases Identification of trends and challenges in national and international supply chains Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push or pull-based strategies, efficiency vs. responsiveness) Elaboration of approaches and goals in the field of resource planning and supplier management Identification and analyzes of concepts in logistics management Implementation of the fields of purchasing, operations and sales into the business strategy Transmission of knowledge concerning demand management and distribution logistics Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods
Literature	Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin. Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 rd edition, Upper Saddle River, NJ, Pearson/Prentice
	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 Scor 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	 Introduction: Overview of current trade flows and development of global business cooperation Networks explanations using neo institutional approaches as a theoretical basis Networks organization and functioning Development stages of networks Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics
Literature	 Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004. Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001. Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008. Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006. Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000. Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009. Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.



Module M0630: Robotics a	nd Navigation in Medicine			
0				
Courses				
Title	05)	Тур	Hrs/wk	CP
Robotics and Navigation in Medicine (L03: Robotics and Navigation in Medicine (L03:		Lecture Project Seminar	2	3
Robotics and Navigation in Medicine (LOS:		Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer	noonation coolion (emaily		•
Admission Requirements	None			
Recommended Previous				
Knowledge	principles of math (algebra, analysis/calcul	ns)		
· ·	principles of programming, e.g., in Java or 0	D++		
	solid R or Matlab skills			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking	systems in clinical contexts and illustrate systems an	d their components in	details. Systems can be
	evaluated with respect to collision detection and s	afety and regulations. Students can assess typical syste	ems regarding design	and limitations.
Skills	The students are able to design and evaluate pavi	gation systems and robotic systems for medical applica	tions	
Skills	The students are able to design and evaluate having	gation systems and robotic systems for medical applica	110115.	
Personal Competence				
•	The students discuss the vessiles of sthese successions		into the six and a	
Social Competence	The students discuss the results of other groups, p	rovide helpful feedback and can incoorporate feedback	into their work.	
Autonomy	The students can reflect their knowledge and docu	ment the results of their work. They can present the resu	ults in an appropriate i	manner.
Workload in Hours	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	Computer Science: Specialisation Intelligence Eng	ineering: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Medical Tec			
	Computational Science and Engineering: Specialis	sation Systems Engineering and Robotics: Elective Cor	npulsory	
	International Management and Engineering: Speci	alisation II. Electrical Engineering: Elective Compulsory	/	
	Mechatronics: Specialisation Intelligent Systems a	nd Robotics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial O	rgans and Regenerative Medicine: Elective Compulsor	у	
	Biomedical Engineering: Specialisation Implants a	nd Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Te	echnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Managem	ent and Business Administration: Elective Compulsory		
	Product Development, Materials and Production: S	pecialisation Product Development: Elective Compulso	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	implementary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	n 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.



Course 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 Navigation 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	
Content	See interlocking course	
Literature	See interlocking course	



Module M0764: Aircraft Sys	stems II			
Courses				
Title		Typ	Hrs/wk	CP
Aircraft Systems II (L0736)		Typ Lecture	3	4
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke	ricolation occiton (large)		-
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge	and the modge on			
ooago	mathematics			
	mechanics			
	thermo dynamics			
	electronics			
	fluid technology			
	control technology			
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence	-			
Knowledge	Students are able to			
	describe the structure of primary flight control systems as v	vell as actuation-, avionic-, fuel- a	nd landing gear-systen	ns in general along with
	corresponding properties and applications.			
	 explain different configurations and designs and their origins 	3		
	 explain atmospheric conditions for icing such as the functional 			
Skills	Students are able to			
	size primary flight control actuation systems			
	 perform a controller design process for the flight control actual 	itors		
	design high-lift kinematics			
	design and analyse landing gear systems			
	design anti-ice systems			
Parcanal Compatance				
Personal Competence	Charleste and able to			
Social Competence	Students are able to:			
	Develop joint solutions in mixed teams			
Autonomy	Students are able to:			
	 derive requirements and perform appropriate yet simplified self-reliant manner 	design processes for aircraft systen	ns from complex issues	and circumstances in a
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points		<u> </u>		
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	on Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production	duct Development: Elective Compuls	ory	
	Product Development, Materials and Production: Specialisation Production			
	Product Development, Materials and Production: Specialisation Materials	erials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems			
	Theoretical Mechanical Engineering: Technical Complementary Cou	ırse: 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	 Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) 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) 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) Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)
Literature	Moir, Seabridge: Aircraft Systems Torenbek: Synthesis of Subsonic Airplane Design Curry: Aircraft Landing Gear Design: Principles and Practices

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 M0811: Medical Ima	iging Systems			
Courses				
Title		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 following	learning results		
Professional Competence				
Knowledge				
	Students can:			
	Describe the system configuration and components of the relationships to the system.	main clinical imaging eveteme:		
	Explain how the system components and the overall system		1;	
	Explain and apply the physical processes that make imagin			
	Name and describe the physical effects required to genera			
	Explain how spatial and temporal resolution can be influent	ced and how to characterize the	images generated;	
	Explain which image reconstruction methods are used to g	enerate images;		
	Describe and explain the main clinical uses of the different system	S.		
Skills	Students are able to:			
	Explain the physical processes of images and assign to the	e systems the basic mathematica	l or physical equations required	d;
	Calculate the parameters of imaging systems using the mathematical or physical equations;			
	 Determine the influence of different system components on the spatial and temporal resolution of imaging systems; 			
	 Explain the importance of different imaging systems for a number of clinical applications; 			
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence	none			
Autonomy	Students can:			
	Understand which physical effects are used in medical ima	aina.		
	Decide independently for which clinical issue a measuring			
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: Electiv	re Compulsory		
Curricula	Biomedical Engineering: Core qualification: Compulsory	raduat Davalanment: Flactive Oc	maulaaru	
	Product Development, Materials and Production: Specialisation Product Development, Materials and Production: Specialisation Production:	·	mpuisory	
	Product Development, Materials and Production: Specialisation M			
	Theoretical Mechanical Engineering: Specialisation Bio- and Med		ilsory	
	Theoretical Mechanical Engineering: Technical Complementary C		•	

Course L0819: Medical Imaging Systems		
Тур	Lecture	
Hrs/wk		
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 W1141. Selected 10	ppics of Product Development, Materials Sci	ence and Froduction (Alternative	A. 12 LF)	
Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Structure and Properties of Composites (L		Lecture	2	3
Elements of Integrated Production System		Problem-based Learning	2	3
Emotional Design / User Centered Produc		Seminar	2	2
Development Management for Mechatron		Lecture	2	3
Design Optimization and Probabilistic App		Seminar	3	3
Fatigue & Damage Tolerance (L0310)		Lecture	2	3
Joining of Polymer-Metal Lightweight Structure	tures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc		Laboratory Course	1	1
Design with Polymers and Composites (LC		Lecture	2	3
	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
			1	1
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)		1
Lightweight Design Practical Course (L12		Problem-based Learning	3	3
Mechanisms, Systems and Processes of		Lecture	2	2
Metallic Materials for Aircraft Applications	LU514)	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	355)	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		Lecture	2	2
		Recitation Section (small)	1	2
Reliability in Engineering Dynamics (L1303)		2	3
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	Only one of the modules "Selected Topics of Product Devi		Alternative A: 12 LF)" or "Selected Topics
	Product Development, Materials Science and Production (Al	ternative B: 6 LP)" can be selected.		
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	owing learning results		
Professional Competence				
Knowledge				
	 Students are able to express their extended knowledge. 	edge and discuss the connection of different	special fields or app	lication areas of prod
	development, materials and production			
	Students are qualified to connect different special fiel	ds with each other		
	·			
Skills				
	 Students can apply specialized solution strategies ar 	nd new scientific methods in selected areas		
	 Students are able to transfer learned skills to new an 	d unknown problems and can develop own sol	ution approaches	
Personal Competence				
Social Competence	Social Competence -			
Autonomy				
,	 Students are able to develop their knowledge and sk 	ills by autonomous election of courses.		
Workload in Hours	Depends on choice of courses			
Credit points	12			
Assignment for the Following	Product Development, Materials and Production: Specialisate	tion Product Development: Elective Compulsor	у	
Curricula	Product Development, Materials and Production: Specialisation	tion Production: Elective Compulsory		



Course L159	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
СР	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
	-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: 9781119933104
	ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	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 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	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Dr. Hans Wittich	
Language	DE	
Cycle	WiSe	
Content		
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	



Course L0513: Structure and Properties of Composites		
Тур	acture	
Hrs/wk		
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
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	
Litanatura	Hall Chara between the Common the materials Commontates University Drawn	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press	
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press	
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of Integrat	ed 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 / U	Jser 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

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. Daniel Steffen
Language	DE
Cycle	SoSe
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development IT systems for product development Establishment of management standards Typical types of organization
Literature	Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Hausarbeit
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
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.

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



	Metal Lightweight Structures
Typ	Lecture 2
Hrs/wk	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	WiSe
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 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 an 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 lightweig structures as well as their application fields.
Literature	
	Lecture Notes and selected papers A LE Charlet for the restriction to materials assigned for application. Provided the latest and the selection of the se
	 J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International 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 L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning
	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

	ction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture
	2
	2
	Independent Study Time 32, Study Time in Lecture 28
	Mündliche Prüfung
	30 min
	Dr. Marco Schürg
Language	
, and the second	WiSe Evaluated of Adiabatic Florida
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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.



Typ	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	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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.

• Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.



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
	 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
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.

	ms and Processes of Materials Testing
	Lecture
Hrs/wk	
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 Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg



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
СР	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
Literature	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	
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 Techr	nology
	Lecture
Hrs/wk	2
CP	4
	Independent Study Time 92, Study Time in Lecture 28
	Mündliche Prüfung
	•
	30 min
Lecturer	Prof. Hoc Khiem Trieu
0 0	EN
Cycle	WiSe
	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping) 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) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, Clark electrode, enzyme electrode, DNA chip) <li< th=""></li<>
	microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes. cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; microelectroplating, 3D-MID)
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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
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
СР	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. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
	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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
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	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin Heidelberg, 2007



Course 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
Literature	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
СР	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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull
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	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, Auto & Design, Corso Frabcia 161, 10139 Torino, Italia

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Aircraft interior international

Engl. magasin for Aircraft cabin interior

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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			
Lecturer	Dr. Rolf Janßen			
Language	DE/EN			
Cycle	WiSe			
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	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			
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing		
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			
СР	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	 Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems 	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Design Methodology			
	Тур	Hrs/wk	CP
	Lecture	3	4
	Recitation Section (small)	1	2
Prof. Josef Schlattmann			
none			
After taking part successfully, students have reached	the following learning results		
Science-based working on product design considering	ng targeted application of specific product design	techniques	
Creative handling of processes used for scientific	preparation and formulation of complex product	design problems / Applic	cation of various produc
Independent Study Time 124, Study Time in Lecture	56		
6			
Oral exam			
International Management and Engineering: Special	isation II. Product Development and Production: E	lective Compulsory	
Mechatronics: Specialisation System Design: Electiv	e Compulsory		
Biomedical Engineering: Specialisation Artificial Org	ans and Regenerative Medicine: Elective Compul	sory	
Biomedical Engineering: Specialisation Implants and	Endoprostheses: Elective Compulsory		
Biomedical Engineering: Specialisation Medical Tec	hnology and Control Theory: Elective Compulsory		
Biomedical Engineering: Specialisation Managemen	at and Business Administration: Elective Compulso	ory	
Product Development, Materials and Production: Spo	ecialisation Product Development: Elective Compu	ılsory	
Product Development, Materials and Production: Spo	ecialisation Production: Elective Compulsory		
Product Development, Materials and Production: Spo	ecialisation Materials: Elective Compulsory		
Theoretical Mechanical Engineering: Specialisation	Product Development and Production: Elective Co	ompulsory	
Theoretical Mechanical Engineering: Technical Com	plementary Course: Elective Compulsory		
	After taking part successfully, students have reached Science-based working on product design considering Creative handling of processes used for scientific places of the study Time of the second se	Typ Lecture Recitation Section (small) Prof. Josef Schlattmann none After taking part successfully, students have reached the following learning results Science-based working on product design considering targeted application of specific product design in Creative handling of processes used for scientific preparation and formulation of complex product design techniques following theoretical aspects. Independent Study Time 124, Study Time in Lecture 56 Goral exam International Management and Engineering: Specialisation II. Product Development and Production: Embeddical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory	Typ Hrs/wk Lecture 3 Rectation Section (small) 1 Prof. Josef Schlattmann none After taking part successfully, students have reached the following learning results Science-based working on product design considering targeted application of specific product design techniques Creative handling of processes used for scientific preparation and formulation of complex product design problems / Applied design techniques following theoretical aspects. Independent Study Time 124, Study Time in Lecture 56 6 Oral exam International Management and Engineering: Specialisation III. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Madical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development and Production: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1523: Mechanical Design M	Methodology
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	 Systematic reflection and analysis of the mechanical design process Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels) Creativity (basics, methods, practical application in mechatronics) Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ) Evaluation and selection (technical-economical evaluation, preference matrix) Value analysis, cost-benefit analysis Low-noise design of technical products Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication) Aesthetic product design (industrial design, colouring, specific examples / exercises)
Literature	 Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007 VDI-Richtlinien: 2206; 2221ff



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



Module M1144: Manufactur	ing with Polymers and Composites - Fr	om Molecule to Part		
Courses				
		Тур	Hrs/wk	CP
Title Manufacturing with Polymers and Composites (L0511)		Lecture	2 a	3
From Molecule to Composites Part (L1516		Problem-based Learning	2	3
	Prof. Bodo Fiedler	3		-
Admission Requirements	Non			
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 polymers and composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practical problems. They 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 Autonomy	Students are able to cooperate in small, mixed-sut engineering. They are able to effectively present and develop alternative approaches to an engineering process. Students are capable of independently solving mech their knowledge using the literature and other sour pragmatically solve them by means of corresponding	explain their results alone or in groups in front of oblem independently or in groups and discuss ad anical engineering problems using provided literaces provided by the supervisor. Furthermore, the	f a qualified audience. Sto vantages as well as draw ature. They are able to fill	udents have the ability to backs. gaps in as well as extent
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	1,5 h			
Assignment for the Following	International Management and Engineering: Speciali	sation II. Product Development and Production: E	lective Compulsory	
Curricula	Materials Science: Specialisation Engineering Materi	·	, ,	
	Mechanical Engineering and Management: Specialis	• •		
	Product Development, Materials and Production: Spe	• •	ılsory	
	Product Development, Materials and Production: Spe		•	
	Product Development, Materials and Production: Spe			
	Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Com			
	0 0 111 11			

Course L0511: Manufacturing with Polymers and 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	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining	
	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding	
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag	
	Crawford: Plastics engineering, Pergamon Press	
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag	
	Åström: Manufacturing of Polymer Composites, Chapman and Hall	



Course L1516: From Molecule to Composites Part				
Тур	Problem-based Learning			
Hrs/wk				
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 M1145: Automation	and Simulation			
Courses				
Title Automation and Simulation (L1525) Automation and Simulation (L1527)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 3 3
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous	BSc Mechanical Engineering or similar			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	Students can describe the structure an the function of process programmable logic computers.		onents, the data trans	fer via bus systems an
	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	hed 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	Teamwork in small teams.			
Autonomy	Students are able to identify the need of methocic analysises in the field of automation systems, to do these analysisis in an adequate manner und to			
	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		<u> </u>	
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Election	ve Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elect			
	International Management and Engineering: Specialisation II. Energia		ective Compulsory	
	International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory			
	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory			
	Mechatronics: Specialisation System Design: Elective Compulsory	ativa Camarilaani		
	Mechatronics: Specialisation Intelligent Systems and Robotics: 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 Materials: Elective Compulsory			
	1 Todas Detailphient, waterials and 1 Todastion, openialisation waterials. Elective Computatory			



Course L1525: Automation and Sim	ulation
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Günter Ackermann
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	Prof. Günter Ackermann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
ïtle		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	ng learning results		
Professional Competence	The making part occording, caucino have readined the lener	ig rearring receive		
Knowledge	Students are able to:			
	 understand systems engineering process models, methods an 	d tools for the development of complex Sys	ems	
	describe innovation processes and the need for technology Ma			
	explain the aircraft development process and the process of type			
	explain the system development process, including requireme			
	identify environmental conditions and test procedures for airbo			
	value the methodology of requirements-based engineering (R		ering (MBRE)	
Skills	Students are able to:			
OKIIIS	• plan the process for the development of complex Systems			
	organize the development phases and development Tasks			
	assign required business activities and technical Tasks apply systems angineering methods and tools.			
	apply systems engineering methods and tools			
Personal Competence				
Social Competence	Students are able to:			
	• understand their responsibilities within a development team ar	d integrate themselves with their role in the	overall process	
Autonomy	Students are able to:			
•	• interact and communicate in a development team which has d	stributed 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: Compulsory			
Curricula	International Management and Engineering: Specialisation II. A	viation Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II. P	roduct Development and Production: Electiv	ve Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulse		-	
	Mechatronics: Specialisation Intelligent Systems and Robotics:			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			



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 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	inery			
0				
Courses		T	Hua hade	OD.
Title		Typ Lecture	Hrs/wk 3	CP
Turbomachines (L1562) Turbomachines (L1563)		Recitation Section (large)	1	4
Module Responsible	Prof. Franz Joos	. Tookakon Cookon (ka go)	•	
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer			
Knowledge	Toolinioa memoaynamico i, ii, maa bynamico, mea mansier			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	3,,	3		
Knowledge	The students can			
· ····································				
	 distinguish the physical phenomena of conversion of energy 	•		
	understand the different mathematic modelling of turboma	chinery,		
	 calculate and evaluate turbomachinery. 			
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
	discuss in small groups and develop an approach.			
Autonomy	The students are able to			
	 develop a complex problem self-consistent, 			
	analyse the results in a critical way,			
	have an qualified 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 Con	npulsory		
	Product Development, Materials and Production: Specialisation P		у	
	Product Development, Materials and Production: Specialisation P	·	•	
	Product Development, Materials and Production: Specialisation M	• •		

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:
- I have to a	 Application cases of turbomachinery Fundamentals of thermodynamics and fluid mechanics Design fundamentals of turbomachinery Introduction to the theory of turbine stage Design and operation of the turbocompressor Design and operation of the steam turbine Design and operation of the gas turbine Physical limits of the turbomachines
Literature	 Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York Menny: Strömungsmaschinen, Teubner., Stuttgart



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	



architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Module M1170: Phenomena	a and Methods in Materials Science				
Title Experimental Methods for the Characteriation of Materials (£1580)	Courses					
Experimental Methods for the Characterization of Materials (L1580) Locture 2 3 Phase equilibria and transformations (L1579) Lecture 2 3 Module Responsible Prof. Patrick Huber Admission Requirements Incompetence Recommended Previous Sundamentals of Materials Science (I and II) Frofessional Competence Removed Prof. Skills and the state of the students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence Social Competence assess their own strengths and weaknesses. • assess their own strengths and weaknesses. • define tasks independently. Morkload in Hours (Autonomy House) Independent Study Time 124, Study Time in Lecture 56 Examination duration and scale (1975) Written exam (1975) Writt			Typ		Hre/wk	CP
Phase equilibria and transformations (L1579) Rodule Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge Askills The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. The students will be able to explain the properties of advanced materials and an anomaterials. The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials consider architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables the select optimum materials combinations depending on the technical applications. Personal Competence Social Competence Autonomy The students are able to • assess their own strengths and weaknesses. • define tasks independently. • assess their own strengths and weaknesses. • define tasks independently. Independent Study Time i124, Study Time in Lecture 56 Examination duration and scale Ominimum terms of the students and scale in the scale		etion of Materials (L1580)		70		
Module Responsible Prof. Patrick Huber Admission Requirements none. Recommended Previous Knowledge Educational Objectives Professional Competence Knowledge The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select Optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to • assess their own strengths and weaknesses. • define tasks independently. Morkload in Hours Independent Study Time in 124, Study Time in Lecture 56 Credit points 6 Examination Murition and scale 90 min	·					
Admission Requirements none. Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Skills The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to • assess their own strengths and weaknesses. • define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination duration and scale 90 min		·				-
Rowledge Educational Objectives Atter taking part successfully, students have reached the following learning results		none.				
Educational Objectives Professional Competence Knowledge Knowledge Knowledge Knowledge The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables the select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to • assess their own strengths and weaknesses. • define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Examination duration and scale Figure 124 Written exam 90 min	Recommended Previous	Fundamentals of Materials Science (I and II)				
Professional Competence Knowledge The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables the select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Knowledge					
Professional Competence Knowledge The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, cera polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Educational Objectives	After taking part successfully, students have reached the	following learning results	3		
polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. Skills The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials conside architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Written exam Examination duration and scale The students will also gain an overview on modern materials considerate and in the consideration and scale and in the macroscale. The students will also gain an overview on modern materials considerate and in the consideration and scale and in the macroscale. The students will also gain an overview on modern materials considerate and in the consideration and scale and in the macroscale. The students will also gain an overview on modern materials considerate and in the consideration and scale and in the macroscale. The students will also gain an overview on modern materials consideration and scale and in the macroscale. The students will also gain an overview on modern materials consideration and scale and in the macroscale. The students will also gain an overview on modern materials consideration and scale and in the macroscale. The students will also gain an overview on modern materials considerate and in the chincal applications.	Professional Competence					
architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables their select optimum materials combinations depending on the technical applications. Personal Competence Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Knowledge	·	_		nnology, in particul	lar metallic, ceramic,
Social Competence The students are able to present solutions to specialists and to develop ideas further. Autonomy The students are able to assess their own strengths and weaknesses. define tasks independently. Morkload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Skills	architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to				
Autonomy The students are able to	Personal Competence					
assess their own strengths and weaknesses. define tasks independently. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Examination Written exam Examination duration and scale 90 min	Social Competence	The students are able to present solutions to specialists and to develop ideas further.				
● 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	Autonomy	The students are able to				
Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Examination Written exam Examination duration and scale 90 min		 assess their own strengths and weaknesses. 				
Credit points 6 Examination Written exam Examination duration and scale 90 min		 define tasks independently. 				
Examination Written exam Examination duration and scale 90 min	Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Examination duration and scale 90 min	Credit points	6				
	Examination	Written exam				
Assignment for the Following International Management and Engineering: Specialisation II Product Development and Production: Floring Computer vi	Examination duration and scale	90 min				
Assignment for the Following International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory	Assignment for the Following	International Management and Engineering: Specialisation	on II. Product Developme	ent and Production: Elective Con	npulsory	
Curricula Materials Science: Core qualification: Compulsory			·		•	
Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory		Product Development, Materials and Production: Special	isation Product Developm	ment: Elective Compulsory		
Product Development, Materials and Production: Specialisation Production: Elective Compulsory		Product Development, Materials and Production: Special	isation Production: Electiv	ve Compulsory		
Product Development, Materials and Production: Specialisation Materials: Compulsory		Product Development, Materials and Production: Special	isation Materials: Compul	Isory		
Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory		Theoretical Mechanical Engineering: Specialisation Mate	erials Science: Elective Co	ompulsory		
Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		Theoretical Mechanical Engineering: Technical Complement	nentary 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	 Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry) 	
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 To	ppics of Product Development, Materials Sci	ence and Production (Alternative	B: 6 LP)		
Courses					
Title Typ Hrs/wk CP					
Applied Automation (L1592)		Problem-based Learning	3	3	
Ergonomics (L0653)		Lecture	2	3	
Structure and Properties of Polymers (L03	389)	Lecture	2	3	
Structure and Properties of Composites (L		Lecture	2	3	
Elements of Integrated Production System		Problem-based Learning	2	3	
Emotional Design / User Centered Produc		Seminar	2	2	
Development Management for Mechatroni		Lecture	2	3	
Design Optimization and Probabilistic Appl		Seminar	3	3	
Fatigue & Damage Tolerance (L0310)	is defined in the decidinal visual year (2.101.1)	Lecture	2	3	
Joining of Polymer-Metal Lightweight Struc	eturas (1.0500)	Lecture	2	2	
Joining of Polymer-Metal Lightweight Struc		Laboratory Course	1	1	
		·	2	3	
Design with Polymers and Composites (Li	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2	
		Lecture	1	4	
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)		1	
Lightweight Design Practical Course (L129		Problem-based Learning	3	3	
Mechanisms, Systems and Processes of		Lecture	2	2	
Metallic Materials for Aircraft Applications	(LU314)	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)	sterials Testing (L0949) Lecture 2 2				
Reliability in Engineering Dynamics (L0176	5)	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	Only one of the modules "Selected Topics of Product Deve	elopment, Materials Science and Production (Alternative A: 12 CF)" or "Selected Topics of	
	Product Development, Materials Science and Production (Al	Iternative B: 6 CP)" can be selected.			
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results			
Professional Competence					
Knowledge					
rmomeage	 Students are able to express their extended knowledge. 	edge and discuss the connection of different	special fields or app	olication areas of produc	
	development, materials and production				
	Students are qualified to connect different special fie	lds with each other			
	4				
Skills					
	 Students can apply specialized solution strategies ar 	nd new scientific methods in selected areas			
	 Students are able to transfer learned skills to new an 	d unknown problems and can develop own sol	ution approaches		
Personal Competence					
Social Competence	 -				
Autonomy					
	Students are able to develop their knowledge and sk	tills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses				
Credit points	· ·				
Assignment for the Following	6 Product Development, Materials and Production: Specialisa	tion Product Development: Flective Compulsor	,		
			,		
Curricula	Product Development, Materials and Production: Specialisa				
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory				



Course L159	Course L1592: Applied Automation		
Тур	Problem-based Learning		
Hrs/wk	3		
СР	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		
	-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: 9781119933104		
	ISBN: 9781118033104 John Wüey & Sons, Inc., 1992		

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	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 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
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites		
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. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
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	
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press	
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

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 Management for Mechatronics		
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. Daniel Steffen	
Language	DE	
Cycle	SoSe	
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development IT systems for product development Establishment of management standards Typical types of organization	
Literature	 Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme 	



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis		
Тур	Seminar	
Hrs/wk	3	
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Hausarbeit	
Examination duration and scale	ca. 10 Seiten und Diskussion	
Lecturer	Prof. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content		
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.	

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	



Hraws 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Examination Form Risusur Examination duration and scale 90 Minuten Lecture Prof. Sergio Amancio Filho Language EN Cycle WiSe 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 lightwelg used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of 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 - 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 Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints Learning Outcomes:	burse L0500: Joining of Polymer-Metal Lightweight Structures		
Workload how Independent Study Time 32, Study Time in Lecture 28 Examination Form Klausur	Тур	Lecture	
Workload in Hours			
Examination Form Kiausur Examination duration and scale So Minutan Cycle WiSe 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 lightweig used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of is to be accomplished through theoretical and practical lectures: Theoretical Lectures - Peview of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reintorced 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 Injection Cliniching 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 structures as well as their application fields. Literature - Lecture Notes and selected papers - J. Fishackelford, Introduction to materials science for engineers, Prentice-Hall International - J. Rothleiser, Joining of Plastics, Handbook for designers and engineers Hanser Publishers - D.A. Growell A. Benatur, J.B. Plastics and Composities Welding Handbook			
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- 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 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 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 • J. Rothelser, Johning of Plastics, Handbook for designers and engineers, Hanser Publishers • D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook		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 applicatio is to be accomplished through theoretical and practical lectures:	
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 D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited 			
		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 L0057: Design with Polymers and Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	DE	
Cycle	WiSe	
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning	
	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	

ours 14544. Limbbusinht Construc	ation with Fibre Paintered Behaviore Churchael Machanica
	ction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture 2
Hrs/wk	2
Workload in Hours Examination Form	Independent Study Time 32, Study Time in Lecture 28
Examination duration and scale	Mündliche Prüfung 30 min
	Dr. Marco Schürg
	DE DE
Cycle	WiSe
-	Fundamentals of Anisotropic Elasticity
Content	Tandamentals of Amsocropic Easticity
	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 str 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 eff 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.



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	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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.
	Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.
	Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	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.
	Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition.



Course L1258: Lightweight Design Practical Course	
Тур	Problem-based Learning
Hrs/wk	3
СР	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
	 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
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.

	ms and Processes of Materials Testing
Тур	Lecture
Hrs/wk	2
СР	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 investigatio of part/materials deficiencies Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg



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
Literature	Introduction/process of aircraft design/various aircraft configurations Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) Statistical methods in overall aircraft design/data base methods Principles of aircraft performance design (stability, V-n-diagramme) Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) Principles of engine design and integration Cruise design Design of runway and landing field length Cabin design (fuselage dimensioning, cabin interior, loading systems) System- and equipment aspects Design variations and operating cost calculation J. Roskam: "Airplane Design"
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	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 Techn	nology
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	
Lecturer	Prof. Hoc Khiem Trieu
Language	
Cycle	WiSe
Content	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping) Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pinction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process; Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnetoresistance, AMR and GMR, fluxgate magnetometer) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, Clark electrode, PNA
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 Manage	ment
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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
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
СР	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 LOCCA: Foodbook Control	Medical Technology
Course L0664: Feedback Control in Medical Technology	
	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
	Taking an engineering point of view, the lecture is structured as follows. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/rehabilitation engineering navigation systems and robotic in medicine 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
СР	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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

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



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	
Literature	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 A	Air Transportation	
Тур	Lecture	
Hrs/wk		
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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull	
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	 Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, 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	JY		
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	Dr. Rolf Janßen		
Language	DE/EN		
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 W.D. Kingery, Introduction to Ceramics", John Wiley & Sons, New York, 1975		
Literature	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		
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing	
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	
СР	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	Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Module M1226: Mechanical	Properties			
Courses				
Title		Тур	Hrs/wk	СР
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 reach	ed the following learning results		
Professional Competence				
Knowledge	Students can explain basic principles of crystall	lography, statics (free body diagrams, tractions) and	d thermodynamics (ener	gy minimization, energy
	barriers, entropy)			
OL III.	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Skills	Students are capable of using standardized calcul	lation methods: tensor calculations, derivatives, integr	als, tensor transformation	18
Personal Competence				
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.			
4.4				
Autonomy	Students are able to			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific term	ns and to define further work steps on this basis guide	d by teachers.	
	and to decree death to see death and a second and a	the self-resolution and the self-resolution and a 26 colors	b d . d	
	- work independently based on lectures and notes	s to solve problems, and to ask for help or clarifications	s wnen needed	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	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: Compulsory	1		
Curricula	Mechanical Engineering and Management: Speci	alisation Materials: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Product Development: Elective Compu	Isory	
	Product Development, Materials and Production: S	Specialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Materials: Compulsory		



Course L1661: Mechanical Behavio	ur of Brittle Materials
Тур	Lecture
Hrs/wk	2
СР	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 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		



Robust Control			
	Тур	Hrs/wk	СР
	Lecture	2	3
	Recitation Section (small)	2	3
Prof. Herbert Werner			
Control Systems Theory and Design			
	locus)		
	n n		
Linear algebra, singular value decomposition	יוו		
After taking part successfully, students have reache	d the following learning results		
• Chudonto con explain the cignificance of the	matrix Diseati equation for the colution of LO problems		
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			or an uncertain plant.
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Students are capable of designing and tunir	ng LOG controllers for multivariable plant models.		
	•	plant, and of using st	tandard software tools
solving it.	, , ,	, ,	
They are capable of translating time and frame.	equency domain specifications for control loops into o	constraints on closed-	loop sensitivity function
and of carrying out a mixed-sensitivity desig	ın.		
They are capable of constructing an LFT und	certainty model for an uncertain system, and of designi	ng a mixed-objective	robust controller.
They are capable of formulating analysis a	and synthesis conditions as linear matrix inequalities	(LMI), and of using	standard LMI-solvers for
solving them.			
They can carry out all of the above using standard software tools (Matlab robust control toolbox).			
Students can work in small groups on specific probi	lems to arrive at joint solutions.		
		mentation) and use it t	to solve given problems.
Stadenio are able to mia required information in sec	2.000 p. 0 1.000 (1.000, 1.000, 1.000, 1.000, 0.000, 0.000)	nomacon, and acc in	io corvo grvori probleme.
Independent Study Time 124, Study Time in Lecture	e 56		
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	ent and Business Administration: Elective Compulsory		
	and business Administration. Elective Compulsory		
	necialisation Product Development: Flective Compuled	rv	
Product Development, Materials and Production: Sp	pecialisation Product Development: Elective Compulso	ry	
Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp	pecialisation Production: Elective Compulsory	ry	
Product Development, Materials and Production: Sp	pecialisation Production: Elective Compulsory pecialisation Materials: Elective Compulsory	ry	
	State space methods Linear algebra, singular value decomposition After taking part successfully, students have reached Students can explain the significance of the They can explain the duality between optim They can explain how the H2 and H-infinity They can explain how an LQG design probl They can explain how and LQG design probl They can explain how model uncertainty can explain how an allysis and synthes Students are capable of designing and tunin They understand how analysis and synthes Students are capable of representing a H2 or list solving it. They are capable of translating time and from and of carrying out a mixed-sensitivity designer they are capable of formulating analysis solving them. They are capable of formulating analysis solving them. They can carry out all of the above using stated they carry in the	Typ Lecture Recitation Section (small) Prof. Herbert Werner Control Systems Theory and Design Control Systems Theory and Design Problems Control Systems They can explain the duality between optimal state feedback and optimal state estimation. They can explain how the H2 and H-Infinity norms are used to represent stability and performance They can explain how the H2 and H-Infinity norms are used to represent stability and performance They can explain how an LOG design problem can be formulated as special case of an H2 design They can explain how and LoG design problem can be formulated as special case of an H2 design They can explain how and LoG design problem can be formulated as special case of an H2 design They can explain how and successfully and performance They can explain how and LoG designing and tuning LOG controllers for multivariable plant models. They are capable of representing a H2 or H-Infinity design problem in the form of a generalized solving It. They are capable of translating time and frequency domain specifications for control loops into and of carrying out a mixed-sensitivity design. They are capable of formulating analysis and synthesis conditions as linear matrix inequalities solving them. They are capable of formulating analysis and synthesis conditions as linear matrix inequalities solving them. They can carry out all of the above using standard software tools (Matlab robust control toolbox). Students can work in small groups on specific problems to arrive at joint solutions. Students can work in small groups on specific problems to arrive at joint solutions	Prof. Herbert Werner Control Systems Theory and Design Classical control (frequency response, root locus) Classical control (frequency response, root locus) Classical control (frequency response, root locus) State space methods Linear algebra, singular value decomposition Alter taking part successfully, students have reached the following learning results Students can explain the significance of the matrix Riccati equation for the solution of LQ problems. They can explain the duality between optimal state feedback and optimal state estimation. They can explain the wild and the standard state feedback and optimal state estimation. They can explain how much 22 and Hinfinity norms are used to represent stability and performance constraints. They can explain how wild be an explain the come and be formulated as special case of an H2 design problem. They can explain how model uncertainty can be represented in a way that lends itself to robust controller design They can explain how an explain wild and synthesis conditions on feedback loops can be represented as linear matrix inequal of the state of the signing and tuning LQG controllers for multivariable plant models. They are capable of designing and tuning LQG controllers for multivariable plant models. They are capable of presenting a H2 or H-Infinity design problem in the form of a generalized plant, and of using stolving it. They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing an mixed-objective of the year capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using solving item. They are capable of formulating analysis and synthesis conditions. Students can work in small groups on specific problems to arrive at joint solutions. Students can work in small groups on specific problems to arrive at joint solutions. Students can work in small groups on specific problems to arrive at joint solutions. Students can work in small groups on specific problems



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

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



f. Uwe Weltin	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 3
	Lecture	3	3
	Lecture	3	3
	Hecitation Section (small)	2	
			3
adamentals of electrical angineering			
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idamentais of electrical engineering			
ad knowledge of mechanics			
ndamentals of control theory			
er taking part successfully, students have reached the	following learning results		
dents are able to describe fundamental properties of	robots and solution approaches for multiple proble	ems in robotics.	
dents are able to derive and solve equations of motio	n for various manipulators.		
dents can generate trajectories in various coordinate	systems.		
dents can design linear and partially nonlinear contro	llers for robotic manipulators.		
dents are able to work goal-oriented in small mixed g	roups.		
dents are able to recognize and improve knowledge	deficits independently.		
h instructor assistance, students are able to evaluate	their own knowledge level and define a further co	urse of study.	
ependent Study Time 110, Study Time in Lecture 70			
tten exam			
) min			
mputer Science: Specialisation Intelligence Engineeri	ng: Elective Compulsory		
mputational Science and Engineering: Specialisation	Systems Engineering and Robotics: Elective Com	npulsory	
rnational Production Management: Specialisation Pro	oduction Technology: Elective Compulsory		
rnational Management and Engineering: Specialisati	on II. Mechatronics: Elective Compulsory		
rnational Management and Engineering: Specialisati	on II. Product Development and Production: Elect	ive Compulsory	
chanical Engineering and Management: Core qualific	ation: Compulsory		
chatronics: Core qualification: Compulsory			
duct Development, Materials and Production: Specia	isation Product Development: Elective Compulso	ry	
duct Development, Materials and Production: Specia	isation Production: Elective Compulsory		
duct Development, Materials and Production: Specia	isation Materials: Elective Compulsory		
eoretical Mechanical Engineering: Specialisation Prod	duct Development and Production: Elective Comp	ulsory	
eoretical Mechanical Engineering: Technical Compler	mentary Course: Elective Compulsory		
	rataking part successfully, students have reached the dents are able to describe fundamental properties of idents are able to derive and solve equations of motio dents can generate trajectories in various coordinate dents can design linear and partially nonlinear control dents are able to work goal-oriented in small mixed godents are able to recognize and improve knowledge of the instructor assistance, students are able to evaluate the ependent Study Time 110, Study Time in Lecture 70 titlen exam In min muter Science: Specialisation Intelligence Engineering mutational Science and Engineering: Specialisation functional Management and Engineering: Specialisation functional Management and Engineering: Specialisation functional Engineering and Management: Core qualific chatronics: Core qualification: Compulsory duct Development, Materials and Production: Special duct Development, Materials an	rataking part successfully, students have reached the following learning results dents are able to describe fundamental properties of robots and solution approaches for multiple proble dents are able to derive and solve equations of motion for various manipulators. dents can generate trajectories in various coordinate systems. dents can design linear and partially nonlinear controllers for robotic manipulators. dents are able to work goal-oriented in small mixed groups. dents are able to recognize and improve knowledge deficits independently. h instructor assistance, students are able to evaluate their own knowledge level and define a further co- ependent Study Time 110, Study Time in Lecture 70 tten exam Dimin Imputer Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Com- putational Production Management: Specialisation Production Technology: Elective Compulsory Immational Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Immational Management and Engineering: Specialisation II. Product Development and Production: Elect Chanical Engineering and Management: Core qualification: Compulsory chatronics: Core qualification: Compulsory duct Development, Materials and Production: Specialisation Production: Elective Compulsory duct Development, Materials and Production: Specialisation Materials: Elective Compulsory duct Development, Materials and Production: Specialisation Materials: Elective Compulsory duct Development, Materials and Production: Specialisation Materials: Elective Compulsory	or taking part successfully, students have reached the following learning results dents are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics, dents are able to derive and solve equations of motion for various manipulators, dents can generate trajectories in various coordinate systems, dents can design linear and partially nonlinear controllers for robotic manipulators, dents can design linear and partially nonlinear controllers for robotic manipulators, dents are able to work goal-oriented in small mixed groups, dents are able to recognize and improve knowledge deficits independently, h instructor assistance, students are able to evaluate their own knowledge level and define a further course of study, ependent Study Time 110, Study Time in Lecture 70 International Science: Specialisation Intelligence Engineering: Elective Compulsory Imputational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory Imputational Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Imputational Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Imputational Engineering and Management: Core qualification: Compulsory International Engineering and Management: Core qualification: Compulsory International Engineering and Management: Specialisation Product Development: Elective Compulsory Iduct Development, Materials and Production: Specialisation Product Development: Elective Compulsory Iduct Development, Materials and Production: Specialisation Materials: Elective Compulsory Iduct Development, Materials and Production: Specialisation Materials: Elective Compulsory Iduct Development, Materials and Production: Specialisation Materials: 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
СР	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 M0719: Biomateria	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 implants and end	doprotheses are recommended.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students can describe the material characteristics of material	lls used in medical engineering, includ	ing their advantages and	disadvantages.
	The students can name the polymers, metals and synthetic mate	rials used in humans.		
	The student has a basic understanding on issues of regenerative	e medicine.		
Skills	The students can explain the advantages and disadvantages of	the materials used in medical enginee	ring.	
	The student can explain and describe the basic principles of cell	use for regenerative medical applicati	ons.	
	The student can use literature databases for accumulation and p	resentation of relevant up-to-date data		
Personal Competence				
Social Competence	The student can lead discussions and participate in them, repres	senting work results.		
	The student can respectfully and adequately work in a team with	his peers.		
Autonomy	The student has the ability to acquire knowledge independently	and transfer the acquired knowledge to	new issues.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, between 20 and 50 questions			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess	Engineering: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II. Pr	ocess Engineering and Biotechnology	: Elective Compulsory	
	Product Development, Materials and Production: Specialisation	Product Development: Elective Compu	ilsory	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory		



Course L0593: Biomaterials	
Тур	Lecture
Hrs/wk	2
CP Workload in House	3 Independent Study Time 62 Study Time in Lecture 29
Workload in Hours Lecturer	Independent Study Time 62, Study Time in Lecture 28 Prof. Michael Morlock
Language	EN EN
Cycle	WiSe
Content	Topics to be covered include:
	Introduction (Importance, nomenclature, relations)
	2. Biological materials
	2.1 Basics (components, testing methods)
	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 Intervertebral discs
	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, properties, reaction of the body)
	4.3 Titan (alloys, properties, reaction of the body)
	4.4 Ceramics and glas (properties, reaction of the body)
	4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)
	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.
	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.
	Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.
	Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.
	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	WiSe
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 Handschel
	(Herausgeber), Hans Peter Wiesmann (Herausgeber): Springer, Berlin; ISBN-10: 3540777547; ISBN-13: 978-3540777540



Module M0771: Flight Phys	ics			
Courses				
Title		Тур	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L03	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				
	Mathematics			
	Mechanics			
	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the following lear	ning 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 Produc	ct Development: Elective Compulsor	y	
	Product Development, Materials and Production: Specialisation Produc	ction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materi	als: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems E			
	Theoretical Mechanical Engineering: Technical Complementary Cours			

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
Language	DE
Cycle	WiSe
Content	 Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)
Literature	Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II Etkin, B.: Dynamics of Atmospheric Flight Sachs/Hafer: Flugmechanik Brockhaus: Flugregelung J.D. Anderson: Introduction to flight



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

Course L0731: Flight Mechanics II	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		
Admission Requirements	None		
Recommended Previous	Good basic-knowledge of Business Administration		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students will gain insights into:		
	Product Planning		
	• Process		
	Methods		
	Design thinking		
	• Process		
	Methods		
	User integration		
Skills	Students will gain deep insights into:		
	Product Planning		
	Process-related aspects		
	Organisational-related aspects		
	Human-Ressource related aspects		
	 Working-tools, methods and instruments 		
	0		
Personal Competence			
Social Competence			
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Interact within a team		
	Raise awareness for globabl issues		
Autonomy			
,	Gain access to knowledge sources		
	Interpret complex cases Develop acceptation shills		
	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		у	
	Mechanical Engineering and Management: Specialisation Management: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Product Development: Elective Compuls	ory	
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Com	oulsory	
	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 Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment Transferring ideas for innovation into feasible concepts which have a high market attractively
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	ependent 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	ement (L0387)	Lecture	2	3
Health, Safety and Environmental Manage	ement (L0388)	Recitation Section (small)	1	1
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous				
Knowledge	Good knowledge in Technologies for Environmental Pro	, , , , , ,		
	Good knowledge of the relevant Environmental Legislat Regis knowledge of instruments for Environmental Asso			
	Basic knowledge of instruments for Environmental Asse	ssment		
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students are able to describe the basics of regulations, e	economic instruments, voluntary initiatives	s, fundamentals of HS	E legislation ISO 14001
	EMAS and Responsible Care ISO 14001 requirements. They can	an analyse and discuss industrial processe	es, substance cycles a	nd approaches from end
	of-pipe technology to eco-efficiency and eco-effectiveness, sho	wing their sound knowledge of complex in	dustry related problem	s. They are able to judge
	environmental issues and to widely consider, apply or carry out	,	n measures and furthe	er interventions as well a
	conceptual problem solving approaches in the full range of prol	olems in different industrial sectors.		
Skills	Students are able to assess current problems and situations i	·	•	
	and to plan and suggest concrete actions in a company- or brai	nch-specific context. By this means they ca	ın solve problems on a	technical, administrative
	and legislative level.			
Davas and Communications				
Personal Competence	The students are used to seller in interesting a large			
Social Competence	The students can work together in international groups.			
Ata. a.a. a	Charles to a second the second th		the discussions The	
Autonomy	Students are able to organize their work flow to prepare themse knowledge by making enquiries independently.	erves for presentations and contributions to	the discussions. They	/ can acquire appropriate
	knowledge by making enquines 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 Environ	mental Engineering: Elective Compulsory		
Curricula	Environmental Engineering: Core qualification: Compulsory			
	Joint European Master in Environmental Studies - Cities and St	ustainability: Specialisation Water: Elective	Compulsory	
	Joint European Master in Environmental Studies - Cities and St	ustainability: Specialisation Energy: Electiv	re Compulsory	
	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulso	ory	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environmental			
	Water and Environmental Engineering: Specialisation Cities: Co	ompulsory		



Course L0502: Integrated Pollution Control		
Тур	Lecture	
Hrs/wk	2	
СР	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 Case Studies: paper industry, cement industry, automotive industry Field Trip 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	 Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives 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 Crisis management
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	Course L0388: Health, Safety and Environmental Management	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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 Enterp	orise		
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 Manageme	ent		
Knowledge				
Educational Objectives	After taking part successfully, students have reached 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 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	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following	International Management and Engineering: Specia	lisation II. Product Development and Production: Electi	ive Compulsory	
Curricula	Logistics, Infrastructure and Mobility: Specialisation	Production and Logistics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Org	gans and Regenerative Medicine: Elective Compulsory		
	Biomedical Engineering: Specialisation Implants an	d Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Ted	chnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manageme	nt and Business Administration: Compulsory		
	Product Development, Materials and Production: Sp	pecialisation Product Development: Elective Compulsor	ry	
	Product Development, Materials and Production: Sp	pecialisation Production: Compulsory		
	Product Development, Materials and Production: Sp	pecialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Product Development and Production: Elective Comp	ulsory	
	Theoretical Mechanical Engineering: Technical Cor	mplementary Course: Elective Compulsory		

Course L0932: The Digital Enterpris	е
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	Modelling of business processes and data, simulation Knowledge and competence management Process management (MRP, workflow management) Computer Aided Planning (CAP) Virtual Reality (VR) and Augmented Reality (AR) Computer Aided Quality Management (CAQ) E-Collaboration
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	ecture	
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	Models of Production and Inventory Management Production Programme Planning and Lot Sizing Order and Capacity Scheduling Selected Strategies of PPC Manufacturing Control Production Controlling Supply Chain Management	
Literature	 Vorlesungsskript Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002 	

Course L0930: Production Planning	Course L0930: Production Planning and Control	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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	СР
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	ve an overview for the field of safety a	nd risk assessment as wel	l as environmental and
	sustainable engineering, in detail:			
	basics in safety and reliability of technical facilities			
	safety and reliability analysis methods			
	risk assessment			
	Production and usage of bio-char			
	energy production and supply			
	sustainable product design			
Skills	Students are able apply interdisciplinary system-oriented m costs for processes and select economically feasible treatment		nability reporting. They can	evaluate the effort and
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from given	n sources and transform it to new ques	tions. Furthermore, they car	n define targets for new
	application or research-oriented duties in for risk manageme impact.			
Workload in Hours	·			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
· ·	Written elaboration			
Examination 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: Floative Compulsors		
Curricula	Product Development, Materials and Production: Specialisation			
		·	ouisor y	
	Product Development, Materials and Production: Specialisati Product Development, Materials and Production: Specialisati			
	Water and Environmental Engineering: Core qualification: Co	, ,		
	water and Environmental Engineering. Core qualification: Co	mpuisory		

Course L1145: Safety, Reliability an	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	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations		
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf		



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			
modulo mirodz. i roduction	and Logictico indiragement			
Courses				
Title		Тур	Hrs/wk	CP
Operative Production and Logistics Manag	gement (L1198)	Lecture	2	2
Strategic Production and Logistics Manage	ement (L1089)	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 par will be distributed during the admission process.	icipation in this module is accessable	via e-learning. Log-in a	nd additional information
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		<u> </u>	<u> </u>	
Knowledge	Students will be able			
	- to differentiate between strategic and operational production a	nd logistics management,		
	- to describe the areas of production and logistics management,			
	- understand the difference between traditional and new concep			
	- to describe and explain the actual challenges of production an	d logistics management, esp. in an inte	ernational context.	
Skills				
	Based on the acquired knowledge students are capable of			
	- Applying methods of production and logistics management in a	an international context,		
	- Selecting sufficient methods of production and logistics manag	ement to solve practical problems,		
	- Selecting appropriate methods of production and logistics man	agement also for non-standardized pro	oblems,	
	- Making a holistic assessment of areas of decision in production	n and logistics management and releva	ant 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 oth	ers,		
	- 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 and	d use suitable means of implementation	١,	
	- define and carry out research tasks bearing in mind possible soc	cietal consequences.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam	<u> </u>	<u> </u>	
Examination duration and scale	120 min			
Assignment for the Following	International Management and Engineering: Core qualification: C	ompulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Compulso	ory		
	Product Development, Materials and Production: Specialisation P	roduct Development: Elective Compuls	sory	
	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	laterials: Elective Compulsory		



Course L1198: Operative Production	n and Logistics Management
Тур	Lecture
Hrs/wk	2
СР	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
	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



Course L1089: Strategic Production	and Logistics Management
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	 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 strategy, 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 lean 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: 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 M1155: Aircraft Cal	bin 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 following learning	ı results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and cabin Systems			
	• explain the functional and non-functional requirements for cabin Systems			
	elucidate the necessity of cabin operating systems and emergency System	ms		
	assess the challenges human factors integration in a cabin environment			
Skills	Students are able to:			
	design a cabin layout for a given business model of an Airline			
	design cabin systems for safe operations			
	design emergency systems for safe man-machine interaction			
	solve comfort needs and entertainment requirements in the cabin			
Personal Competence				
Social Competence	Students are able to:			
	• understand existing system solutions and discuss their ideas with experts	3		
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 Compulsory			
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory			
	International Management and Engineering: Specialisation II. Aviation Sys	tems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Product De	evelopment: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production	n: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engir	neering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary Course: E	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	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006

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 M1183: Laser syste	ems and methods of manufacturing desig	n and analysis		
Courses				
Title		Тур	Hrs/wk	СР
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	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	isation Product Development: Elective Co	mpulsory	
Curricula	Product Development, Materials and Production: Specia	isation Production: Compulsory		
	Product Development, Materials and Production: Specia	isation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Production	duct Development and Production: Elective	e Compulsory	
	Theoretical Mechanical Engineering: Technical Complete	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	 Fundamentals of laser technology Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers Laser system technology: beam forming, beam guidance systems, beam motion and beam control Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment Quality assurance and economical aspects of laser material processing Markets and Applications of laser technology Student group exercises
Literature	 Hügel, H., T. Graf: Laser in der Fertigung: Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014. Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010. Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010. J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005. Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011



Course L0876: Methods for Analysing Production Processes		
Тур	Lecture	
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	 Modelling and simulation of maching and forming processes Numerical simulation of forces, temperatures, deformation in machining Analysis of vibration problems in maching (chatter, modal analysis,) Knowledge based process planning Design of experiments Machinability of nonmetallic materials Analysis of interaction between maching process and machine tool systems with regard to process stability and quality Simulation of maching processes by virtual reality methods 	
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 M1174: Automation	n Technology and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Handling and Assembly Systems (L1591)		Lecture	2	2
Handling and Assembly Systems (L1738)		Recitation Section (small)	1	1
Automation 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				
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence	, , , , , , , , , , , , , , , , , , ,	<u> </u>		
Knowledge	Students			
, une moage				
	 know the characteristic components of an automation systems a 	nd have good understanding of thei	ir interaction	
	 know methods for a systematical analysis of automation tasks ar 	d are able to use them		
	have special competences in industrial robot based automation	systems		
0.00				
Skills	Students are able to			
	analyze complex Automation tasks			
	develop application based concepts and solutions			
	develop application based concepts and solutions design subsystems and integrate into one system			
	investigate and evaluate safety of machinery			
		a llava		
		ollers		
	design of circuit for pneumatic applications			
Personal Competence				
Social Competence	Students are able to			
	- find solutions for automation and handling tasks in groups			
	- develop solutions in a production environment with qualified personn	el at technical level and represent d	ecisions.	
Autonomy	Students are able to			
	analyze automation tasks independently			
	 generate programs for robots and programmable logic devices a 	utonomously		
	 develop solutions for practice oriented tasks of automation indep 	pendently		
	 design safety concepts for automation applications 			
	assess consequences of their professional actions and responsi	bilities		
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	Product Development, Materials and Production: Specialisation Produc	Development: Elective Compulsor	у	
Curricula	Product Development, Materials and Production: Specialisation Produc			
	Product Development, Materials and Production: Specialisation Materia			
	Theoretical Mechanical Engineering: Specialisation Product Development		ılsorv	
	Theoretical Mechanical Engineering: Specialisation Product Developing Theoretical Mechanical Engineering: Technical Complementary Course	·		
	mooretour mooranical Engineering. recrimical completiteitary course	License Compaisory		



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

Course L1738: Handling and Assembly Systems		
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		
Literature		

Course L1	590: Automation Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Introduction to the production Automation including their different fields of application, importent terms, automation history and upcoming trends -Overview of different actuator concepts and their principles -Design of pneumatic wiring diagrams -Energyefficency in the production -Review of automatic identification systems like Barcode and RFID -Overview of the structure, components and algorithms of an image processing system -Introduction to buscommunication an the different general concepts -Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends
Literature	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 Hans-Jürgen Gevatter, Ulrich Grünhaupt: Handbuch der Mess- und Automatisierungstechnik in der Produktion



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 M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)			
ourses			
itle	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		



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.

Module M0763: Aircraft Sys	stems I			
Courses				
Title		Тур	Hrs/wk	СР
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 foll	owing learning results		
Professional Competence				
Knowledge	Students are able to:			
	Describe essential components and design points of	hydraulic clostrical and high lift systems		
	Give an overview of the functionality of air conditionin			
	Explain the need for high-lift systems such as ist fund			
	Assess the challenge during the design of supply systems			
	- 7.00000 the diality of dailing the design of supply 35.	sterilo or arranoran		
Skills	Students are able to:			
	Design hydraulic and electric supply systems of aircr	rafts		
	Design high-lift systems of aircrafts			
	Analyze the thermodynamic behaviour of air condition	ning systems		
Personal Competence				
Social Competence	Students are able to:			
	Perform system design in groups and present and di	scuss results		
Autonomy	Students are able to:			
	Reflect the contents of lectures autonomously			
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: Elective C	ompulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compulsor	ry		
	International Management and Engineering: Specialisation	II. Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisa	tion Product Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specialisa	tion Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisa	tion Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft	Systems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complemen	ntary Course: Elective Compulsory		



Course L0735: Aircraft Systems I		
Тур	Lecture	
Hrs/wk		
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	WiSe	
Content	 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) Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems) 	
Literature	 Moir, Seabridge: Aircraft Systems Green: Aircraft Hydraulic Systems Torenbek: Synthesis of Subsonic Airplane Design SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes 	

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 En	terprise		
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 Manag	gement		
Knowledge				
Educational Objectives	After taking part successfully, students have reached 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				
Personal Competence				
Social Competence	Students can develop joint solutions in mixed teams and present them to others.			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following		pecialisation II. Product Development and Production: Elec	ctive Compulsory	
Curricula		ation Production and Logistics: Elective Compulsory	ouvo compandony	
		al Organs and Regenerative Medicine: Elective Compulso	rv	
	Biomedical Engineering: Specialisation Implan		.,	
		al Technology and Control Theory: Elective Compulsory		
	* * '	gement and Business Administration: Compulsory		
	0 0 1	n: Specialisation Product Development: Elective Compuls	ory	
	Product Development, Materials and Production		•	
	' '	n: Specialisation Materials: Elective Compulsory		
	' '	ation Product Development and Production: Elective Com	pulsory	
	Theoretical Mechanical Engineering: Technical	•	. ,	

Course L0932: The Digital Enterprise		
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Axel Friedewald	
Language	DE	
Cycle	WiSe	
Content	Modelling of business processes and data, simulation Knowledge and competence management Process management (MRP, workflow management) Computer Aided Planning (CAP) Virtual Reality (VR) and Augmented Reality (AR) Computer Aided Quality Management (CAQ) E-Collaboration	
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		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Hermann Lödding	
Language	pe DE	
Cycle	WiSe	
Content	Models of Production and Inventory Management Production Programme Planning and Lot Sizing Order and Capacity Scheduling Selected Strategies of PPC Manufacturing Control Production Controlling Supply Chain Management	
Literature	 Vorlesungsskript Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002 	

Course L0930: Production Planning and Control		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	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 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 M1183: Laser syste	ems and methods of manufacturing desig	n and analysis		
Courses				
Title		Тур	Hrs/wk	СР
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	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	lisation Product Development: Elective Co	mpulsory	
Curricula	Product Development, Materials and Production: Specia	lisation Production: Compulsory		
	Product Development, Materials and Production: Specia	lisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Pro	duct Development and Production: Elective	e Compulsory	
	Theoretical Mechanical Engineering: Technical Comple	mentary Course: Elective Compulsory		

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



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	Modelling and simulation of maching and forming processes Numerical simulation of forces, temperatures, deformation in machining Analysis of vibration problems in maching (chatter, modal analysis,) Knowledge based process planning Design of experiments Machinability of nonmetallic materials Analysis of interaction between maching process and machine tool systems with regard to process stability and quality Simulation of maching processes by virtual reality methods	
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 M1174: Automation	n Technology and Systems			
Courses				
Title		Тур	Hrs/wk	CP
Handling and Assembly Systems (L1591)		Lecture	2	2
Handling and Assembly Systems (L1738)		Recitation Section (small)	1	1
Automation 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				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	Students			
	know the characteristic components of an automation systems and	have good understanding of their int	eraction	
	know methods for a systematical analysis of automation tasks and		eraction	
	have special competences in industrial robot based automation systems.			
	nave special competences in industrial robot based automation sy	Sterns		
Skills	Students are able to			
	analyze complex Automation tasks			
	develop application based concepts and solutions			
	design subsystems and integrate into one system			
	investigate and evaluate safety of machinery			
	create simple programs for robots and programmable logic control	llers		
	design of circuit for pneumatic applications			
Personal Competence				
Social Competence	Students are able to			
eddiai edinpeterio				
	- find solutions for automation and handling tasks in groups			
	- develop solutions in a production environment with qualified personnel at technical level and represent decisions.			
Autonomy	Students are able to			
	analyze automation tasks independently			
	 generate programs for robots and programmable logic devices au 	tonomously		
	 develop solutions for practice oriented tasks of automation indepe 	ndently		
	 design safety concepts for automation applications 			
	assess consequences of their professional actions and responsible	ilities		
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	Product Development, Materials and Production: Specialisation Product D	Development: Elective Compulsory		
Curricula	Product Development, Materials and Production: Specialisation Production	n: Compulsory		
	Product Development, Materials and Production: Specialisation Materials	: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Developmen	at and Production: Elective Compulsor	y	
	Theoretical Mechanical Engineering: Technical Complementary Course:	Elective Compulsory		



Course L1	Course L1591: Handling and Assembly Systems		
Тур	Lecture		
Hrs/wk	2		
СР	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		

Course L1738: Handling and Assembly Systems		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L1	590: Automation Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Introduction to the production Automation including their different fields of application, importent terms, automation history and upcoming trends -Overview of different actuator concepts and their principles -Design of pneumatic wiring diagrams -Energyefficency in the production -Review of automatic identification systems like Barcode and RFID -Overview of the structure, components and algorithms of an image processing system -Introduction to buscommunication an the different general concepts -Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends
Literature	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
	Hans-Jürgen Gevatter, Ulrich Grünhaupt: Handbuch der Mess- und Automatisierungstechnik in der Produktion



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	



ourses				
itle		Тур	Hrs/wk	СР
omputer and communication technology	in cabin electronics and avionics (L1557)	Lecture	2	2
omputer and communication technology	in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
odel-Based Systems Engineering (MBSI	e) with SysML/UML (L1551)	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			
	Province Installation for			
	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:			
	describe the structure and operation of computer architectures			
	• explain the structure and operation of digital communication Networks			
	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			
Skills	Students are able to:			
	understand, operate and maintain a Minicomputer			
	build up a network communication and communicate with other			
	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:			
	organize and schedule their practical tasks			
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: I	lective Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation			
Gurricula	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		·v	
	Product Development, Materials and Production: Specialisation		,	
	Product Development, Materials and Production: Specialisation			



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
СР	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	- 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 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. Raif 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
Literature	- 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 (Generation from Wind and Hydro Power			
Courses				
Title		Тур	Hrs/wk	СР
Renewable Energy Projects in Emerged N	farkets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)	ianco (20014)	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 follo	owing learning results		
Professional Competence	<u>,</u>			
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 an can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water 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 s theoretical background and are thus able to transfer what the		e their understanding an	d the application of th
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 m	ultidisciplinary within a seminar.		
Autonomy	Students can independently exploit sources in the context of particular knowledge about the subject area.	of the emphasis of the lecture material to	clear the contents of the le	ecture and to acquire th
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: Ele	ctive Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elect			
	Energy and Environmental Engineering: Specialisation Ener			
	International Management and Engineering: Specialisation I		ry	
	International Management and Engineering: Specialisation I			
	Product Development, Materials and Production: Specialisat			
	Product Development, Materials and Production: Specialisat	·	•	
	Product Development, Materials and Production: Specialisat	' '		
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process	Engineering: Elective Compulsorv		
	Water and Environmental Engineering: Specialisation Enviro	0 0 ,		
	J J	: Elective Compulsory		



Course L0014: Renewable Energy F	Projects in Emerged Markets	
Тур	Project Seminar	
Hrs/wk	1	
CP	1	
Workload in Hours	endent Study Time 16, Study Time in Lecture 14	
Lecturer	reas Wiese	
Language	DE	
Cycle		
Content		
	1. Introduction	
	Development of renewable energies worldwide	
	■ History	
	■ Future markets	
	Special challenges in new markets - Overview	
	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	Folian dar Verlagung	
Literature	Folien der Vorlesung	

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



Course L0011: Wind Turbine Plants	ourse L0011: Wind Turbine Plants	
Тур	е	
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	Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion	
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005	

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



courses				
itle		Тур	Hrs/wk	CP
upply Chain Management (L1218)		Problem-based Learning	3	4
alue-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	no			
Recommended Previous	no			
Knowledge				
	After taking part successfully, students have reached t	he following learning recults		
Educational Objectives	After taking part successfully, students have reached t	The following learning results		
Professional Competence	Command developments in intermediated by since a satisfactor	itiaa ayah aa aytaa walaa affahaalaa lataa ahaa allaa la	ation and alabalization	
Knowledge	Current developments in international business activ	nies such as outsourcing, oilsnoring, internationaliz	alion and globalization	n and emerging ma
	illustrated by examples from practice.	d aumply about management and use in 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 vari	ous theories 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.		
	to illustrate phases of network formation.			
	to understand the functional mechanisms of inter-org	•		
	to explain and categorize relationships within network			
	to categorize sourcing concepts and explain motives			
	advantages and disadvantages of offshoring and outsourcing and to illustrate the distinction between the two terms.			
	to state criteria/ factors/ parameters that influence pro	oduction location decisions at the global level (total n	etwork costs).	
	• to explain methods for location finding/evaluation.			
	to interpret phenotypes of production networks.			
	recognize relationships between R & D and producti			
	to solve sub-problems with the configuration of logis:	ics networks (distribution and spare parts networks)	by the use of appropri	iate approaches.
	to categorise special waste logistics including their d	uties & objectives and to state and describe practica	examples of good ne	tworking.
Skille	to asses trends and challenges in national and interi	national supply chains and logistics networks and the	air consequences for c	omnanies
Okina	to evaluate, anaylse and systematise networks and response.		iii consequences ioi c	ompanies.
	to analyse partners and their suitability for co-operations.			
	to select sourcing concepts for specific products /		Il ac advantages and	disadvantages of
		product components based on the lecture as we	i as auvainages and	uisauvaillages oi
	approach.	D beard or consents		
	• to evaluate location decisions for production and R &		10 O - 1- 120 1	-16 data ta 120
	• to recognize relationships between R & D and pro	oduction as well as their locations and to evaluate	the suitability of spe	cilic models for alli
	situations.	attack and a second a second and a second an		
	to transfer the analyzed concepts to international pra			
	to analyse and evaluate the product development pr			
	to analyse concepts of Information and communication			
	to design subcontracting, procurement, production a			
	to plan reorganise efficient and flow-oriented enterprine			
	to adopt methods of complexity management and ris	k management in logistics.		
Personal Competence				
Social Competence	• to evaluate intercultural and international relationshi	ns hased on discussed case studios		
30ciai Competence			a la atura	
	advance planning and design of network formation and design of programment strategies for individual particular and design of programment strategies fo	· ·		
	definition of procurement strategies for individual parameters of the procurement network (outernal/internal).			o well ca an the fi
	design of the procurement network (external/internal)	i/modules etc.) based on the sourcing concepts and	core competencies, a	is well as on the fin
	of the case studies.			
	to make decision of location for production taking		and buying/selling m	arkets, which were
	discussed in the case studies and their dependence of			
	Decision on R & D locations based on the insights ga	ained from case studies / practical examples and the	selection of an approp	priate model.
Autonomy	After completing the module students are capable	to work independently on the subject of Supply C	hain Management ar	nd transfer the acc
rationomy	knowledge to new problems.	to work independently on the subject of Supply C	main wanagement at	id transfer the dog
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
	120 min	selies I Floribus Mosses and Fig. 2		
Assignment for the Following	International Management and Engineering: Specialis			
	LL agretice Intractructure and Mobility: Considiration D	roduction and Logistics: Elective Compulsory		
Curricula				
Curricula	Product Development, Materials and Production: Spec	cialisation Product Development: Elective Compulso	ту	
Curricula		cialisation Product Development: Elective Compulso cialisation Production: Elective Compulsory	ry	



	Double or beautiful and a second or
Typ Hrs/wk	Problem-based Learning 3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE
Cycle	
Content	 Transmission of a profound understanding in logistics and supply chain management Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts business cases Identification of trends and challenges in national and international supply chains Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push pull-based strategies, efficiency vs. responsiveness) Elaboration of approaches and goals in the field of resource planning and supplier management Identification and analyzes of concepts in logistics management Implementation of the fields of purchasing, operations and sales into the business strategy Transmission of knowledge concerning demand management and distribution logistics Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods
Literature	Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin. Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 rd edition, Upper Saddle River, NJ, Pearson/Prenti-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 Busine 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. McGraw-Hill.
	Supply Chain Council (2010): Supply Chain Operations Reference (SCOR) model: Overview – Version 10.0, [online] :: http://supplychain.org/fi/Web ScOverview.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	 Introduction: Overview of current trade flows and development of global business cooperation Networks explanations using neo institutional approaches as a theoretical basis Networks organization and functioning Development stages of networks Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics
Literature	 Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004. Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001. Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008. Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006. Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000. Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009. Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.



Module M0630: Robotics a	nd Navigation in Medicine			
Courses				
Title		Тур	Hrs/wk	CP
Robotics and Navigation in Medicine (L03)	35)	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				
Knowledge	 principles of math (algebra, analysis/calcul 	us)		
· ·	principles of programming, e.g., in Java or	C++		
	solid R or Matlab skills			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking	systems in clinical contexts and illustrate systems an	d their components in	details. Systems can be
	evaluated with respect to collision detection and s	afety and regulations. Students can assess typical syste	ems regarding design	and limitations.
Skills	The students are able to design and evaluate navi	gation systems and robotic systems for medical applica	tions	
Okins	The students are able to design and evaluate havi	gation systems and robotic systems for medical applica	10113.	
Personal Competence				
•	The shirt sale of sales are supplied to the		into the six and a	
Social Competence	The students discuss the results of other groups, p	rovide helpful feedback and can incoorporate feedback	into their work.	
Autonomy	The students can reflect their knowledge and docu	ment the results of their work. They can present the results	ults in an appropriate i	manner.
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following	Computer Science: Specialisation Intelligence Eng	gineering: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Medical Tec	hnology: Elective Compulsory		
	Computational Science and Engineering: Speciali	sation Systems Engineering and Robotics: Elective Cor	npulsory	
	International Management and Engineering: Spec	ialisation II. Electrical Engineering: Elective Compulsory	/	
	Mechatronics: Specialisation Intelligent Systems a	nd Robotics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial O	rgans and Regenerative Medicine: Elective Compulsor	у	
	Biomedical Engineering: Specialisation Implants a	nd Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical To	echnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Managem	ent and Business Administration: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Product Development: Elective Compulso	ory	
	Product Development, Materials and Production: S	specialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Co	emplementary Course: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	n Bio- and Medical Technology: Elective Compulsory		

Course L0335: Robotics and Naviga	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.		



Course L0338: Robotics and Naviga	Course 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	Course L0336: Robotics and Navigation 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	
Content	See interlocking course	
Literature	See interlocking course	



Module M0764: Aircraft Sys	stems II			
Courses				
Title		Typ	Hrs/wk	CP
		Тур	3	4
Aircraft Systems II (L0736) Aircraft Systems II (L0740)		Lecture Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke	recitation Section (large)	2	2
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge	basic knowledge of.			
Kilomeage	mathematics			
	mechanics			
	thermo dynamics			
	electronics			
	fluid technology			
	control technology			
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	Students are able to			
	describe the structure of primary flight control systems as v	well as actuation-, avionic- fuel- a	nd landing gear-system	ns in general along with
	corresponding properties and applications.	,,,	Te tamening gran eyeten	99
	 explain different configurations and designs and their origins 	3		
	 explain atmospheric conditions for icing such as the functions 			
Skills	Students are able to	,		
	size primary flight control actuation systems			
	 perform a controller design process for the flight control actual 	ators		
	design high-lift kinematics			
	design and analyse landing gear systems			
	design anti-ice systems			
Pareanal Compatance				
Personal Competence	Studente are able to:			
Social Competence	Students are able to:			
	Develop joint solutions in mixed teams			
Autonomy	Students are able to:			
	 derive requirements and perform appropriate yet simplified self-reliant manner 	design processes for aircraft system	ns from complex issues	and circumstances in a
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. Aviation	on Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production		ory	
	Product Development, Materials and Production: Specialisation Production			
	Product Development, Materials and Production: Specialisation Materials	erials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems			
	Theoretical Mechanical Engineering: Technical Complementary Co.	urse: 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	 Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) 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) 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) Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)
Literature	Moir, Seabridge: Aircraft Systems Torenbek: Synthesis of Subsonic Airplane Design Curry: Aircraft Landing Gear Design: Principles and Practices

Course L0740: Aircraft Systems II	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		



M. J. J. MOOAA M. J. J.	altern Construer			
Module M0811: Medical Ima	iging Systems			
Courses				
Title		Тур	Hrs/wk	CP
Medical Imaging Systems (L0819)		Lecture	4	6
Module Responsible	Dr. Michael Grass	Lootaro		
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		-		
Knowledge				
	Students can:			
	Describe the system configuration and components of the relationships and components of the relationships are supplied to the relationships and the relationships are supplied to the relationships and the relationships are supplied to the r	main clinical imaging eveteme:		
	Explain how the system components and the overall system.		n:	
	Explain and apply the physical processes that make imagin			
	Name and describe the physical effects required to genera		, , , ,	
	Explain how spatial and temporal resolution can be influent	ced and how to characterize the	images generated;	
	Explain which image reconstruction methods are used to g	enerate images;		
	Describe and explain the main clinical uses of the different system	S.		
Skills	Students are able to:			
	 Explain the physical processes of images and assign to the 	systems the basic mathematica	I or physical equations required	i;
	 Calculate the parameters of imaging systems using 	the mathematical or physical eq	uations;	
	 Determine the influence of different system component 	ents on the spatial and temporal	resolution of imaging systems;	
	 Explain the importance of different imaging systems 	for a number of clinical applicat	ions;	
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence	none			
Autonomy	Students can:			
	Understand which physical offects are used in medical imp	ging:		
	 Understand which physical effects are used in medical ima Decide independently for which clinical issue a measuring 			
	- Decide independently for which difficult issue a fineasting	System dan be decd.		
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: Elective	re Compulsory		
Curricula	Biomedical Engineering: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation Pr	·	mpulsory	
	Product Development, Materials and Production: Specialisation Product Development Materials and Production: Specialisation Product Development			
	Product Development, Materials and Production: Specialisation M Theoretical Mechanical Engineering: Specialisation Bio- and Med		dean	
	Theoretical Mechanical Engineering: Specialisation Bio- and Med Theoretical Mechanical Engineering: Technical Complementary C		пооту	
		Sa. Sa. Elective Compulsory		

Course L0819: Medical Imaging Systems		
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 10	ppics of Product Development, Materials Sc	ience and Production (Alternative	A: 12 LP)	
Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Structure and Properties of Composites (L		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 Mechatroni		Lecture	2	3
Design Optimization and Probabilistic Appl		Seminar	3	3
Fatigue & Damage Tolerance (L0310)	, , ,	Lecture	2	3
Joining of Polymer-Metal Lightweight Structure	tures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc		Laboratory Course	1	1
Design with Polymers and Composites (LC		Lecture	2	3
	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Course (L12		Problem-based Learning	3	3
Mechanisms, Systems and Processes of		Lecture	2	2
Metallic Materials for Aircraft Applications		Lecture	2	3
* *	20017	Lecture	2	2
Aircraft Design I (L0820)			1	2
Aircraft Design I (L0834)		Recitation Section (large)	•	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	355)	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	9)	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	Only one of the modules "Selected Topics of Product Dev	velonment Materials Science and Production (Alternative A: 12 I P	")" or "Selected Tonics
Admission requirements	Product Development, Materials Science and Production (A		Allomativo At 12 Er	, or colocica ropics
Recommended Previous	None			
Knowledge	None			
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge				
rinomeage	 Students are able to express their extended know 	ledge and discuss the connection of different	special fields or app	lication areas of prod
	development, materials and production			
	Students are qualified to connect different special field.	elds with each other		
	special lie			
Skills				
	 Students can apply specialized solution strategies a 	nd new scientific methods in selected areas		
	 Students are able to transfer learned skills to new are 	nd unknown problems and can develop own sol	ution approaches	
Personal Competence				
Social Competence	-			
Autonomy				
Autonomy	Students are able to develop their knowledge and s	kills by autonomous election of courses.		
Workload in Hours	Depends on choice of courses			
Credit points	12			
Assignment for the Following	Product Development, Materials and Production: Specialisa	ation Product Development: Elective Compulsor	y	
	Product Development, Materials and Production: Specialisa	ation Production: Floative Compulsory		
Curricula	Froduct Development, Materials and Froduction. Specialisa	tion Floduction. Liective Compaisory		



Course L159	2: Applied Automation
Тур	Problem-based Learning
Hrs/wk	3
СР	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
	-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 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
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
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. Bodo Fiedler
Language	EN
Cycle	WiSe
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
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of Integrat	ed 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

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. Daniel Steffen
Language	DE
Cycle	SoSe
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development IT systems for product development Establishment of management standards Typical types of organization
Literature	Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Hausarbeit
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
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.

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



Course L0500: Joining of Polymer-Metal Lightweight Structures	
Typ	Lecture
Hrs/wk	2
СР	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	WiSe
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 structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications 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 and 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 lightweight 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 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 L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning
	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

2	of any of the Parish and Parish a
	ction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture 2
Hrs/wk	2
	Independent Study Time 32, Study Time in Lecture 28
Workload in Hours Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
	Dr. Marco Schürg
	DE DE
Cycle	WiSe
	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 effect 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.



Typ	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	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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.

• Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.



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
	 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
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.

	ms and Processes of Materials Testing
Тур	Lecture
Hrs/wk	2
СР	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 Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg



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
СР	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
Literature	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	
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	
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	
Lecturer	Prof. Hoc Khiem Trieu
Language	EN Turns
Cycle	WiSe
Content	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Eiching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermopile and bolometer) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor; piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process; Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnetoresistive sensors: magnetoresistive sensors: magnetoresistive sensors; metal oxide semiconductor gas sensor, clark electrode, play electrode, DNA chip) Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active,
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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
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
СР	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. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine 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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
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	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007



Course 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	
Literature	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 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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull
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	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, Auto & Design, Corso Frabcia 161, 10139 Torino, Italia

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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 Technolog	ay .		
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	Dr. Rolf Janßen		
Language	DE/EN		
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		
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing	
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	 Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems 	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Module M1143: Mechanical	L Donian Mothodology			
Module WT 143. Mechanica	Design Methodology			
Courses				
Title		Тур	Hrs/wk	СР
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 follow	ving learning results		
Professional Competence				
Knowledge	Science-based working on product design considering targete	d application of specific product design ted	hniques	
01.71		and form letter of constant and at the	atana and black Analy	
Skills	Creative handling of processes used for scientific preparation design techniques following theoretical aspects.	on and formulation of complex product de	sign problems / Appli	cation of various produc
	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				
Assignment for the Following	International Management and Engineering: Specialisation II.	Product Development and Production: Elec	ctive Compulsory	
Curricula	Mechatronics: Specialisation System Design: Elective Comput	sory		
	Biomedical Engineering: Specialisation Artificial Organs and F	Regenerative Medicine: Elective Compulso	ry	
	Biomedical Engineering: Specialisation Implants and Endopro	stheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technology a	and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and Bus	siness Administration: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	n Product Development: Elective Compuls	ory	
	Product Development, Materials and Production: Specialisation	n Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product D	evelopment and Production: Elective Com	pulsory	
	Theoretical Mechanical Engineering: Technical Complementa	ry Course: Elective Compulsory		

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



Course L1524: Mechanical Design Methodology		
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	 Systematic reflection and analysis of the mechanical design process Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels) Creativity (basics, methods, practical application in mechatronics) Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ) Evaluation and selection (technical-economical evaluation, preference matrix) Value analysis, cost-benefit analysis Low-noise design of technical products Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication) Aesthetic product design (industrial design, colouring, specific examples / exercises) 	
Literature	 Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007 VDI-Richtlinien: 2206; 2221ff 	



Module M1144: Manufactur	ing with Polymers and Composites - F	rom Molecule to Part		
Courses				
Title		Тур	Hrs/wk	CP
Manufacturing with Polymers and Composites (L0511)		Lecture	2	3
From Molecule to Composites Part (L1516		Problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	Non			
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 tech relationships. They are capable of describing and explain the typical process of solving practical problem.	communicating relevant problems and questions		•
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practical problems. They 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 Autonomy	e Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of civil engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability to develop alternative approaches to an engineering problem independently or in groups and discuss advantages as well as drawbacks.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	1,5 h			
Assignment for the Following	International Management and Engineering: Specia	lisation II. Product Development and Production: Ele	ective Compulsory	
Curricula	Materials Science: Specialisation Engineering Mate	•	. ,	
	Mechanical Engineering and Management: Speciali	• •		
	Product Development, Materials and Production: Sp	ecialisation Product Development: Elective Compul	sory	
	Product Development, Materials and Production: Sp	ecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Sp	ecialisation Materials: Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Materials Science: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Con	nplementary Course: Elective Compulsory		

Course L0511: Manufacturing with Polymers and 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	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining	
	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding	
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag	
	Crawford: Plastics engineering, Pergamon Press	
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag	
	Åström: Manufacturing of Polymer Composites, Chapman and Hall	



Course L1516: From Molecule to Co	omposites 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 M1145: Automation	n and Simulation			
Courses				
Title		Тур	Hrs/wk	СР
Automation and Simulation (L1525)		Lecture	3	3
Automation and Simulation (L1527)		Recitation Section (large)	2	3
Module Responsible	Prof. Günter Ackermann			
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 comp	onents, the data trans	fer via bus systems a
	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	our of three-phase machines.		
Skills	Students can describe and design simple controllers using establishments	shed methodes.		
	They are able to assess the basic characterisitcs of a given automa	ation system and to evaluate, if it is ade	quate for a given plant.	
	They can modell and simulate technical systems with respect to the	eir dynamical behaviour and can use N	Matlab/Simulink for the si	mulation.
	They are able to applay established methods for the caclulation of	the dynamical behaviour of three-pha	se 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	ive Compulsory		
Guiricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elect			
	International Management and Engineering: Specialisation II. Ene		ective Compulsorv	
	International Management and Engineering: Specialisation II. Avia			
	International Management and Engineering: Specialisation II. Proc		ctive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsory	·		
	Mechatronics: Specialisation Intelligent Systems and Robotics: Ele			
	Product Development, Materials and Production: Specialisation Pr		ory	
	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	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Günter Ackermann	
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	Prof. Günter Ackermann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
ïtle		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			
	Amorali Guom Gyalama			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students are able to:			
	• understand systems engineering process models, methods an	d tools for the development of complex Sys	tems	
	• describe innovation processes and the need for technology Ma	anagement		
	\bullet explain the aircraft development process and the process of \mbox{typ}	pe certification for aircraft		
	\bullet explain the system development process, including requireme	nts for systems reliability		
	• identify environmental conditions and test procedures for airbo	rne Equipment		
	• value the methodology of requirements-based engineering (RI	BE) and model-based requirements engine	ering (MBRE)	
Skills	Students are able to:			
	• plan the process for the development of complex Systems			
	organize the development phases and development Tasks			
	assign required business activities and technical Tasks			
	apply systems engineering methods and tools			
Personal Competence				
	Students are able to:			
Social Competence	Students are able to:			
	understand their responsibilities within a development team ar	a integrate themselves with their role in the	overali process	
Autonomy	Students are able to:			
	• interact and communicate in a development team which has di	stributed 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: Compulsory			
Curricula	International Management and Engineering: Specialisation II. A	viation Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II. P		ve Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsor			
	Mechatronics: Specialisation Intelligent Systems and Robotics:			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			



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 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	ninery			
Courses				
Title		Тур	Hrs/wk	CP
Turbomachines (L1562) Turbomachines (L1563)		Lecture Recitation Section (large)	3 1	4
Module Responsible	Prof. Franz Joos	ricolitation occiton (large)		L
Admission Requirements	none			
Recommended Previous	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer			
Knowledge	resimon monitorina i, ii, mata bynamics, mate mansier			
Educational Objectives	After taking part successfully, students have reached the following learni	na results		
Professional Competence	,	9		
Knowledge	The students can			
	distinguish the physical phenomena of conversion of energy,			
	understand the different mathematic modelling of turbomachinery	<i>'</i> ,		
	calculate and evaluate turbomachinery.			
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
	discuss in small groups and develop an approach.			
Autonomy	The students are able to			
	develop a complex problem self-consistent,			
	analyse the results in a critical way,			
	 have an qualified exchange with other students. 			
Workload in Hours	, , ,			
Credit points				
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 Compulso			
	Product Development, Materials and Production: Specialisation Product		У	
	Product Development, Materials and Production: Specialisation Producti			
	Product Development, Materials and Production: Specialisation Material	s: 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:
Literature	 Application cases of turbomachinery Fundamentals of thermodynamics and fluid mechanics Design fundamentals of turbomachinery Introduction to the theory of turbine stage Design and operation of the turbocompressor Design and operation of the steam turbine Design and operation of the gas turbine Physical limits of the turbomachines
Literature	 Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York Menny: Strömungsmaschinen, Teubner., Stuttgart



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 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	learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced	materials along with their applic	cations in technology, in parti	cular metallic, ceramic,
	polymeric, semiconductor, modern composite materials (biomateria	als) and nanomaterials.		
Skills	The students will be able to select material configurations according	rding to the technical needs and	d, if necessary, to design nev	v materials considering
	architectural principles from the micro- to the macroscale. The stud	-		-
	select optimum materials combinations depending on the technica	I applications.		
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to dev	elop ideas further.		
Autonomy	The students are able to			
	assess their own strengths and weaknesses.			
	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. Prod	luct Development and Production	n: Elective Compulsory	
Curricula	Materials Science: Core qualification: Compulsory			
	Product Development, Materials and Production: Specialisation Pr	·	mpulsory	
	Product Development, Materials and Production: Specialisation Pr			
	Product Development, Materials and Production: Specialisation Ma			
	Theoretical Mechanical Engineering: Specialisation Materials Scient			
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: 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	 Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry) 	
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 To	ppics of Product Development, Materials Sc	ience 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
Structure and Properties of Polymers (L03	389)	Lecture	2	3
Structure and Properties of Composites (L		Lecture	2	3
Elements of Integrated Production System		Problem-based Learning	2	3
Emotional Design / User Centered Produc		Seminar	2	2
Development Management for Mechatron		Lecture	2	3
Design Optimization and Probabilistic App		Seminar	3	3
Fatigue & Damage Tolerance (L0310)	(Lecture	2	3
Joining of Polymer-Metal Lightweight Struc	tures (1.0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Struc		Laboratory Course	1	1
			2	3
Design with Polymers and Composites (Li		Lecture		•
	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Course (L12		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	(1.0664)	Lecture	2	3
Renewable Energy (L0313)	(======,	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
	DEE\		3	3
System Analysis in Air Transportation (L0)	555)	Lecture		
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	3)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible Prof. Dieter Krause				
Admission Requirements	Only one of the modules "Selected Topics of Product Dev	elopment, Materials Science and Production (A	Alternative A: 12 CP	e)" or "Selected Topics o
	Product Development, Materials Science and Production (A	Iternative B: 6 CP)" can be selected.		
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	lowing learning results		
Professional Competence				
Knowledge				
	 Students are able to express their extended knowledge. 	edge and discuss the connection of different s	special fields or app	lication areas of produc
	development, materials and production			
	 Students are qualified to connect different special fie 	elds with each other		
	,			
Skills				
	 Students can apply specialized solution strategies a 	nd new scientific methods in selected areas		
	 Students are able to transfer learned skills to new ar 	nd unknown problems and can develop own solu	ution approaches	
Personal Competence				
Social Competence	-			
Autonomy				
	 Students are able to develop their knowledge and sl 	kills by autonomous election of courses.		
Workload in Hours	Depends on choice of courses			
Credit points	6	tion Deadunt Development 51 - 11 - 2		
Assignment for the Following	Product Development, Materials and Production: Specialisa		1	
Curricula	Product Development, Materials and Production: Specialisa	tion Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisa	tion Materials: Elective Compulsory		



Course L1592: Applied Automation		
Тур	Problem-based Learning	
Hrs/wk	3	
СР	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		
Cycle	SoSe	
	-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 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
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
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	
Eliciature	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press	
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of Integrat	ed 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 / U	Iser 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 Management for Mechatronics		
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. Daniel Steffen	
Language	DE	
Cycle	SoSe	
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development IT systems for product development Establishment of management standards Typical types of organization	
Literature	 Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme 	



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis		
Тур	Seminar	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Hausarbeit	
Examination duration and scale	ca. 10 Seiten und Diskussion	
Lecturer	Prof. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content		
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.	

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



Course L0500: Joining of Polymer-M	Metal Lightweight Structures
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
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 structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications 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 and 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 lightweight 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 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 L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning
	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

Course L1514: Lightweight Constru	ction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	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 their 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.



Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
xamination 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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.
	 Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. To a C.A. Markett H.H. Barting and earlier at life of control of the control of
	 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.

Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage



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
	 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
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, System	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	
	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines	
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg	



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
СР	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
Literature	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	
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 Techn	nology
Тур	
Hrs/wk	2
CP	4
Workload in Hours	
	Mündliche Prüfung
Examination duration and scale	
Lecturer	Prof. Hoc Khiem Trieu
Language	
Cycle	WiSe
	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping) 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) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, Clark electrode,
	 cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
Litaratura	
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 LOCCA, Foodbook Control	Medical Technology
Course L0664: Feedback Control in	
	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
	Taking an engineering point of view, the lecture is structured as follows. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine 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
СР	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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

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



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
Literature	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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull
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	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, 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	JY
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	Dr. Rolf Janßen
Language	DE/EN
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 W.D. Kingery, Introduction to Ceramics", John Wiley & Sons, New York, 1975
Literature	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	
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing
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
СР	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 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	 Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems 	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Module M1226: Mechanical	Properties			
Courses				
Title		Тур	Hrs/wk	СР
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 reach	ed the following learning results		
Professional Competence				
Knowledge	Students can explain basic principles of crystall	lography, statics (free body diagrams, tractions) and	d thermodynamics (ener	gy minimization, energy
	barriers, entropy)			
01.71				
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			18
Personal Competence				
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.			
4.4				
Autonomy	Students are able to			
	- assess their own strengths and weaknesses			
	- access their own state of learning in specific term	ns and to define further work steps on this basis guide	d by teachers	
	- assess their own state of learning in specific term	is and to define farmer work steps on this basis guide	d by teachers.	
	- work independently based on lectures and notes	s to solve problems, and to ask for help or clarifications	s when needed	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Materials Science: Core qualification: Compulsory	1		
Curricula	Mechanical Engineering and Management: Speci	alisation Materials: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Product Development: Elective Compu	lsory	
	Product Development, Materials and Production: S	Specialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	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			
	Continuing of about with of british made vials			
	Scattering of strength of brittle materials Defect distribution, strength distribution, Weibull distribution			
	Delect distribution, strength distribution, weight distribution			
	Heterogeneous materials I			
	Internal stresses, micro cracks, weight function,			
	Heterogeneous materials II			
	ghening mechanisms: crack bridging, fibres			
	erogeneous materials III ghening mechanisms. Process zone			
	Todgholling moondinand. Thoosas 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	d Robust Control			
Courses				
Title		Тур	Hrs/wk	СР
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	Control Systems Theory and Design			
Recommended Previous	Classical analysis (for success, washington)			
Knowledge	 Classical control (frequency response, root locus) State space methods 			
	Linear algebra, singular value decomposition			
	- Elliear algebra, singular value decomposition			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	 Students can explain the significance of the matrix 	x Riccati equation for the solution of LQ problems.		
	They can explain the duality between optimal stat			
	They can explain how the H2 and H-infinity norms		constraints.	
	They can explain how an LQG design problem can			
	They can explain how model uncertainty can be			
	They can explain how - based on the small gain to	heorem - a robust controller can guarantee stabili	ty and performance fo	or an uncertain plant.
	 They understand how analysis and synthesis con 	ditions on feedback loops can be represented as	linear matrix inequali	ties.
Skilla				
Skills	Students are capable of designing and tuning LQ	G controllers for multivariable plant models.		
	 They are capable of representing a H2 or H-infir 	nity design problem in the form of a generalized	plant, and of using st	andard software tools fo
	solving it.			
	 They are capable of translating time and frequer 	ncy domain specifications for control loops into c	onstraints on closed-	loop sensitivity functions
	and of carrying out a mixed-sensitivity design.			
	They are capable of constructing an LFT uncertain	nty model for an uncertain system, and of designing	ng a mixed-objective	robust controller.
	They are capable of formulating analysis and s	ynthesis conditions as linear matrix inequalities	(LMI), and of using	standard LMI-solvers fo
	solving them.			
	They can carry out all of the above using standard	d software 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 (lecture notes, literature, software docum	nentation) and use it t	o solve given problems.
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 Engineeri	ng: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Control and Power	Systems: Elective Compulsory		
	Energy Systems: Core qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Syst	ems: Elective Compulsory		
	Computational Science and Engineering: Specialisation	Systems Engineering and Robotics: Elective Com	pulsory	
	Mechatronics: Specialisation System Design: Elective Co	ompulsory		
	Mechatronics: Specialisation Intelligent Systems and Rol	• •		
	Biomedical Engineering: Specialisation Artificial Organs		•	
	Biomedical Engineering: Specialisation Implants and Engineering:			
	Biomedical Engineering: Specialisation Medical Technol			
	Biomedical Engineering: Specialisation Management an			
	Product Development, Materials and Production: Special	·	ry	
	Product Development, Materials and Production: Special	• •		
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory			
	Theoretical Mechanical Engineering: Core qualification: Theoretical Mechanical Engineering: Technical Compler	• •		
	mooreasa Meenamea Engineering. Technical Complet	nontary oourse. Liebuve Compulsory		



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

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 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 F	Prof. Uwe Weltin			
Admission Requirements				
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Prood knowledge of machanics			
"	Broad knowledge of mechanics			
F	Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge S	Students are able to describe fundamental properties of robots an	d solution approaches for multiple proble	ems in robotics.	
Skills S	Students are able to derive and solve equations of motion for variety	ous manipulators.		
	Students can generate trajectories in various coordinate systems.			
5	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 S	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	urse 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	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: Electi	ve Compulsory	
1	Mechanical Engineering and Management: Core qualification: Co	mpulsory		
1	Mechatronics: Core qualification: Compulsory			
F	Product Development, Materials and Production: Specialisation P	roduct Development: Elective Compulsor	ry	
F	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
F	Product Development, Materials and Production: Specialisation N	aterials: Elective Compulsory		
[Theoretical Mechanical Engineering: Specialisation Product Deve	elopment and Production: Elective Comp	ulsory	
	Theoretical Mechanical Engineering: Technical Complementary (FI " 0 1		

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	
	rajectory 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 M0719: Biomateria	ls 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 implants and end	oprotheses are recommended.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students can describe the material characteristics of materia	s used in medical engineering, inclu	ding their advantages and	disadvantages.
	The students can name the polymers, metals and synthetic mate	rials used in humans.		
	The student has a basic understanding on issues of regenerative	medicine.		
Skills	The students can explain the advantages and disadvantages of the materials used in medical engineering. The student can explain and describe the basic principles of cell use for regenerative medical applications.			
	The student can use literature databases for accumulation and presentation of relevant up-to-date data.			
Personal Competence				
Social Competence	The student can lead discussions and participate in them, representing work results.			
	The student can respectfully and adequately work in a team with his peers.			
Autonomy	The student has the ability to acquire knowledge independently and transfer the acquired knowledge to new issues.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, between 20 and 50 questions	<u> </u>		<u> </u>
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess	Engineering: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II. Pr	ocess Engineering and Biotechnolog	y: Elective Compulsory	
	Product Development, Materials and Production: Specialisation	Product Development: Elective Comp	oulsory	
	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary	Course: Elective Compulsory		



Course L0593: Biomaterials		
Тур	Lecture	
Hrs/wk	2	
CP Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Michael Morlock	
Language	EN	
Cycle	WiSe	
Content	Topics to be covered include:	
	Introduction (Importance, nomenclature, relations)	
	Biological materials	
	2.1 Basics (components, testing methods)	
	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 Intervertebral discs	
	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, properties, reaction of the body)	
	4.3 Titan (alloys, properties, reaction of the body)	
	4.4 Ceramics and glas (properties, reaction of the body)	
	4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)	
	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.	
	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.	
	Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.	
	Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.	
	Wintermantel, E. und Ha, SW: Biokompatible Werkstoffe und Bauweisen. Berlin, Springer, 1996.	



Course L0347: Regenerative Medicine		
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	WiSe	
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 Handschel	
	(Herausgeber), Hans Peter Wiesmann (Herausgeber): Springer, Berlin; ISBN-10: 3540777547; ISBN-13: 978-3540777540	



ics			
	Тур	Hrs/wk	CP
727)	Lecture	3	3
		_	2
	Recitation Section (large)	1	1
Prof. Frank Thielecke			
None			
Basic knowledge in:			
a Mathematica			
•			
Aviation			
After taking part successfully, students have reached	the following learning results		
Independent Study Time 96, Study Time in Lecture 8	4		
6			
Written exam			
120 Minutes (WS) + 90 Minutes (SS)			
Aircraft Systems Engineering: Core qualification: Compulsory			
International Management and Engineering: Special	lisation II. Aviation Systems: Elective Compulsory		
Product Development, Materials and Production: Spo	ecialisation Product Development: Elective Compuls	sory	
Product Development, Materials and Production: Spo	ecialisation Production: Elective Compulsory		
Product Development, Materials and Production: Spe	ecialisation Materials: Elective Compulsory		
•			
	Mathematics Mechanics Thermodynamics Aviation After taking part successfully, students have reached Independent Study Time 96, Study Time in Lecture 8 Written exam 120 Minutes (WS) + 90 Minutes (SS) Aircraft Systems Engineering: Core qualification: Co. International Management and Engineering: Special Product Development, Materials and Production: Sp. Theoretical Mechanical Engineering: Specialisation	727) Typ Lecture Lecture Recitation Section (large) Prof. Frank Thielecke None Basic knowledge in: Mathematics Mechanics Thermodynamics Aviation After taking part successfully, students have reached the following learning results Independent Study Time 96, Study Time in Lecture 84 Written exam 120 Minutes (WS) + 90 Minutes (SS) Aircraft Systems Engineering: Core qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory	Typ Hrs/wk Lecture 3 Lecture 2 Recitation Section (large) 1 Prof. Frank Thielecke None Basic knowledge in: • Mathematics • Mechanics • Mechanics • Aviation After taking part successfully, students have reached the following learning results Independent Study Time 96, Study Time in Lecture 84 6 Written exam 120 Minutes (WS) + 90 Minutes (SS) Aircraft Systems Engineering: Core qualification: Compulsory 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 Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: 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
Language	DE
Cycle	WiSe
Content	 Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)
Literature	Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II Etkin, B.: Dynamics of Atmospheric Flight Sachs/Hafer: Flugmechanik Brockhaus: Flugregelung J.D. Anderson: Introduction to flight



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

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 Problem-based Learning	3	3
Product Planning Seminar (L0853)		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	learning results		
Professional Competence				
Knowledge	Students will gain insights into:			
	Product Planning			
	Process			
	 Methods 			
	Design thinking			
	o Process			
	 Methods 			
	 User integration 			
Skills	Students will gain deep insights into:			
	Product Planning			
	 Process-related aspects 			
	 Organisational-related aspects 			
	Human-Ressource related aspects			
	 Working-tools, methods and instruments 			
	٥			
B				
Personal Competence				
Social Competence	Interact within a team			
	Raise awareness for globabl issues			
Autonomy	Gain access to knowledge sources			
	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. Elect			
	Mechanical Engineering and Management: Specialisation Manage			
	Product Development, Materials and Production: Specialisation Pr		у	
	Product Development, Materials and Production: Specialisation Pr			
	Product Development, Materials and Production: Specialisation Ma			
	Theoretical Mechanical Engineering: Specialisation Product Deve		ilsory	
	Theoretical Mechanical Engineering: Technical Complementary C	burse: 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 Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment Transferring ideas for innovation into feasible concepts which have a high market attractively
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	dependent Study Time 62, Study Time in Lecture 28	
Lecturer	rof. Cornelius Herstatt	
Language	N .	
Cycle	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 Integrated Pollution Control (L0502)		Typ Lecture	Hrs/wk	CP 2
Health, Safety and Environmental Manage Health, Safety and Environmental Manage		Lecture Recitation Section (small)	2	3 1
Module Responsible	NN	Hecitation Section (Smail)		
Admission Requirements	none			
Recommended Previous Knowledge	Good knowledge in Technologies for Environmental Prote Good knowledge of the relevant Environmental Legislatio Basic knowledge of instruments for Environmental Assess	1		
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence Knowledge	The students are able to describe the basics of regulations, ecc EMAS and Responsible Care ISO 14001 requirements. They can of-pipe technology to eco-efficiency and eco-effectiveness, showing environmental issues and to widely consider, apply or carry out in conceptual problem solving approaches in the full range of problems.	analyse and discuss industrial processe ng their sound knowledge of complex in novative technical solutions, remediatio	es, substance cycles ar dustry related problem	nd approaches from end- s. They are able to judge
Skills	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available technique and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on 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 themselv knowledge by making enquiries independently.	es for presentations and contributions to	the discussions. They	can acquire appropriate
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 Environmental	ental Engineering: Elective Compulsory		
Curricula	Environmental Engineering: Core qualification: Compulsory			
	Joint European Master in Environmental Studies - Cities and Sust	• •		
	Joint European Master in Environmental Studies - Cities and Sus			
	Product Development, Materials and Production: Specialisation P	·	ory	
	Product Development, Materials and Production: Specialisation P			
	Product Development, Materials and Production: Specialisation N Water and Environmental Engineering: Specialisation Environme			
	Water and Environmental Engineering: Specialisation Cities: Con	npulsory		



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 focuses on: The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip
Literature	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	 Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives 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 Crisis management 	
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	ourse 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: Sustainabi	ity and Risk Management			
Courses				
Title		Тур	Hrs/wk	СР
Safety, Reliability and Risk Assessment (_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	e following learning results		
Professional Competence				
Knowledge	Students are able to describe single techniques and	to give an overview for the field of safety a	nd risk assessment as we	II as environmental an
	sustainable engineering, in detail:			
	basics in safety and reliability of technical facilities.	as		
	safety and reliability analysis methods			
	risk assessment			
	Production and usage of bio-char			
	energy production and supply			
	sustainable product design			
Skills	Students are able apply interdisciplinary system-orien costs for processes and select economically feasible tre		nability reporting. They can	evaluate the effort an
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from application or research-oriented duties in for risk mana 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: Specialisa	tion II. Civil Engineering: Elective Compulsory	/	
	Product Development, Materials and Production: Specia	alisation Product Development: Elective Com	oulsory	
	Product Development, Materials and Production: Specia	alisation Production: Elective Compulsory		
	Product Development, Materials and Production: Specia	alisation Materials: Elective Compulsory		
	Water and Environmental Engineering: Core qualification	on: Compulsory		

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: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf



Course L0319: Environment and Su	stainability
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.



Courses				
Title		Тур	Hrs/wk	CP
ntegrated Product Development II (L1254		Lecture	3	3
ntegrated 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 at	nd applying CAE systems		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	After passing the module students are able to:			
	 explain technical terms of design methodology, 			
	describe essential elements of construction ma			
	describe current problems and the current state			
		3 p		
Skills	After passing the module students are able to:			
	select and apply proper construction methods from the select and apply proper construction method	or non-standardized solutions of problems as well	as adapt new boundar	v conditions.
	solve product development problems with the a	· ·		, ,
	 choose and execute appropriate moderation te 	• • • • • • • • • • • • • • • • • • • •		
Personal Competence				
Social Competence	After passing the module students are able to:			
	 prepare and lead team meetings and moderation 	on processes,		
	 work in teams on complex tasks, 			
	 represent problems and solutions and advance 	ideas.		
Automorphis	After a section the second development and the s			
Autonomy	After passing the module students are able to:			
	give a structured feedback and accept a critical	feedback,		
	 implement the accepted feedback autonomous 			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
	6	J		
Credit points				
Examination	Oral exam			
Examination duration and scale	30 Minuten			
Assignment for the Following	Aircraft Systems Engineering: Specialisation Cabin Systems (1.0 or the property of the propert			
Curricula	Aircraft Systems Engineering: Specialisation Air Trans		ativa Compulation	
	International Management and Engineering: Specialis Mechatronics: Specialisation System Design: Elective	•	cuve Compulsory	
	Product Development, Materials and Production: Spec	• •		
	Product Development, Materials and Production: Spec			
	Product Development, Materials and Production: Spec			
	Theoretical Mechanical Engineering: Specialisation Pr		npulsory	
	Theoretical Mechanical Engineering: Technical Compl	•	,	



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 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 management
	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 managemen 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	 Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007. Beckmann, H.: Supply Chain Management, Berlin, Springer 2004. Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007. 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 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 M1002: Production	and Logistics Management			
modulo mirodz. i roduction	and Logictico indiragement			
Courses				
Title		Тур	Hrs/wk	CP
Operative Production and Logistics Manag	gement (L1198)	Lecture	2	2
Strategic Production and Logistics Manage	ement (L1089)	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 par will be distributed during the admission process.	icipation in this module is accessable	via e-learning. Log-in a	nd additional information
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		<u> </u>	<u> </u>	
Knowledge	Students will be able			
	- to differentiate between strategic and operational production a	nd logistics management,		
	- to describe the areas of production and logistics management,			
	- understand the difference between traditional and new concep			
	- to describe and explain the actual challenges of production an	d logistics management, esp. in an inte	ernational context.	
Skills				
	Based on the acquired knowledge students are capable of			
	- Applying methods of production and logistics management in a	an international context,		
	- Selecting sufficient methods of production and logistics manag	ement to solve practical problems,		
	- Selecting appropriate methods of production and logistics man	agement also for non-standardized pro	oblems,	
	- Making a holistic assessment of areas of decision in production	n and logistics management and releva	ant 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 oth	ers,		
	- 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 and	d use suitable means of implementation	١,	
	- define and carry out research tasks bearing in mind possible soc	cietal consequences.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam	<u> </u>	<u> </u>	
Examination duration and scale	120 min			
Assignment for the Following	International Management and Engineering: Core qualification: C	ompulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Compulso	ory		
	Product Development, Materials and Production: Specialisation P	roduct Development: Elective Compuls	sory	
	Product Development, Materials and Production: Specialisation P	roduction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation N	laterials: Elective Compulsory		



Course L1198: Operative Production	n and Logistics Management
Тур	Lecture
Hrs/wk	2
СР	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
	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



Course L1089: Strategic Production	and Logistics Management
Тур	Problem-based Learning
Hrs/wk	3
СР	4
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 strategy, 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 lean 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: 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 M1025: Fluidics				
Courses				
Title		Тур	Hrs/wk	СР
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Problem-based Learning	1	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, hydro	statics, kinematics and kinetics), fluid me	echanics, and enginee	ring design
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence	3,			
Knowledge	After passing the module students are able to			
	 explain structures and functionalities of hydrostatic, pneum 	atic, and hydrodynamic components,		
	explain the interaction of hydraulic components in hydrauli			
	 explain open and closed loop control of hydraulic systems 			
	 describe functioning and applications of hydrodynamic to 	rque converters, brakes and clutches as	s well as centrifugal p	umps and aggregates i
	plant technology			
Skills	After passing the module students are able to			
	analyse and assess hydraulic and pneumatic components	•		
	 design and dimension hydraulic systems for mechanical applications, 			
	 perform numerical simulations of hydraulic systems based 			
	select and adapt pump characteristic curves for hydraulic s	•		
	dimension hydrodynamic torque converters and brakes 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.			
Autonomi	After a section the grandule students are able to			
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	International Management and Engineering: Specialisation II. Med	hatronics: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II. Pro		tive Compulsory	
Garricula	Product Development, Materials and Production: Specialisation P	•	Compaisory	
	Product Development, Materials and Production: Specialisation P			
	Product Development, Materials and Production: Specialisation M			
	Theoretical Mechanical Engineering: Specialisation Product Deve		uisory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		



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
	Tiyorotatios
	physical fundamentals
	hydraulic fluids
	hydrostatic machines
	• valves
	• components
	hydrostatic transmissions
	examples from industry
	Pneumatics
	generation of compressed air
	pneumatic motors Everyples 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
	a calculation / dimensioning of hydrodynamic torque convertors
	calculation / dimensioning of hydrodynamic torque converters calculation / dimensioning of centrifugal pumps
	calculation / dimensioning of centinugar pumps creating and reading of characteristic curves of pumps and systems
	Greating and reading of characteristic curves of pumps and systems
	Field trip
	field trip to a regional company from the hydraulic industry.
	and the date of th
	Exercise
	Non-rised simulation of hodge static posts are
	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
	(partly) self-organised teamwork
Literature	Bücher
Literature	
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011
	, , , , , , , , , , , , , , , , , , ,
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006

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



<u></u>				
Courses				
litle little		Тур	Hrs/wk	СР
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 th	e following learning results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and	d cabin Systems		
	• explain the functional and non-functional requirement	s for cabin Systems		
	• elucidate the necessity of cabin operating systems and	d emergency Systems		
	assess the challenges human factors integration in a content of the challenges human factors integration in a content of the challenges human factors integration in a content of the challenges human factors integration in a content of the challenges human factors integration in a content of the challenges human factors integrated in the challenges human factors integrated in the challenges human factors integrated in the challenges human factors in the challenges human	cabin environment		
Skills	Students are able to:			
	design a cabin layout for a given business model of an	n Airline		
	design cabin systems for safe operations			
	design emergency systems for safe man-machine inter-	raction		
	solve comfort needs and entertainment requirements	n the cabin		
Personal Competence				
Social Competence	Students are able to:			
	• understand existing system solutions and discuss their	r ideas with experts		
Autonomy	Students are able to:			
	Reflect the contents of lectures and expert presentation	ns 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: Electi	ve Compulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Comp			
	International Management and Engineering: Specialisa	tion II. Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Speci	alisation Product Development: Elective Compulso	ry	
	Product Development, Materials and Production: Speci	alisation Production: Elective Compulsory		
	Product Development, Materials and Production: Speci	alisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Air	craft Systems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Comple	ementary Course: Elective Compulsory		



Course L1545: Aircraft Cabin Systems		
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	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006	

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 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	



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	stems I			
Courses				
itle		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	following learning results		
Professional Competence				
Knowledge	Students are able to:			
	Describe essential components and design poin	ts of hydraulia, alastrical and high lift systems		
	Give an overview of the functionality of air condit			
	Explain the need for high-lift systems such as ist			
	Assess the challenge during the design of supply			
	The state of the s	, ofotomo or an anotan		
Skills	Students are able to:			
	Design hydraulic and electric supply systems of a	aircrafts		
	Design high-lift systems of aircrafts			
	Analyze the thermodynamic behaviour of air con	ditioning systems		
Personal Competence				
Social Competence	Students are able to:			
	Perform system design in groups and present an	d discuss results		
Autonomy	Students are able to:			
	Reflect the contents of lectures autonomously			
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: Elective	ve Compulsory		
Curricula	Aircraft Systems Engineering: Core qualification: Compu	ulsory		
	International Management and Engineering: Specialisat	tion II. Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specia	lisation Product Development: Elective Compulsor	у	
	Product Development, Materials and Production: Specia	lisation Production: Elective Compulsory		
	Product Development, Materials and Production: Specia	llisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Airc	craft Systems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Comple	mentary Course: Flective Compulsory		



Course L0735: Aircraft Systems I		
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	WiSe	
Content	 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) Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems) 	
Literature	 Moir, Seabridge: Aircraft Systems Green: Aircraft Hydraulic Systems Torenbek: Synthesis of Subsonic Airplane Design SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes 	

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 To	ppics of Product Development, Materials Sc	eience and Production (Alternative	A: 12 LP)	
Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592)		Problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L03	89)	Lecture	2	3
Structure and Properties of Composites (I		Lecture	2	3
Elements of Integrated Production System		Problem-based Learning	2	3
Emotional Design / User Centered Produc		Seminar	2	2
Development Management for Mechatron		Lecture	2	3
Design Optimization and Probabilistic App		Seminar	3	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		Laboratory Course	1	1
Design with Polymers and Composites (Li		Lecture	2	3
	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
			1	1
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)		1
Lightweight Design Practical Course (L12		Problem-based Learning	3	3
Mechanisms, Systems and Processes of		Lecture	2	2
Metallic Materials for Aircraft Applications	LU514)	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)	355)	Lecture	3	3
Technical Design (L1513)	333)	Lecture	2	3
		Lecture	2	3
Ceramics Technology (L0379)				3
Materials Testing (L0949)		Lecture	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	Only one of the modules "Selected Topics of Product Dev	velopment, Materials Science and Production (Alternative A: 12 LP)" or "Selected Topics
	Product Development, Materials Science and Production (A	Alternative B: 6 LP)" can be selected.		
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence				
Knowledge				
Miowieuge	 Students are able to express their extended know 	rledge and discuss the connection of different	special fields or app	olication areas of prod
	development, materials and production			
	Students are qualified to connect different special field.	elds with each other		
	2.833.1.5 a.5 qua53 to obtilioot amoront special lit	340 34.5.		
Skills				
	 Students can apply specialized solution strategies a 	and new scientific methods in selected areas		
	 Students are able to transfer learned skills to new are 	nd unknown problems and can develop own sol	ution approaches	
Personal Competence				
Social Competence -				
· ·				
Autonomy Students are able to develop their knowledge and skills by au		skills by autonomous election of courses.		
	,			
Workload in Hours	Workload in Hours Depends on choice of courses			
Credit points	12			
Assignment for the Following	Product Development, Materials and Production: Specialisa	ation Product Development: Elective Compulsor	y	
	Product Development, Materials and Production: Specialisa	ation Production: Floative Compulsory		
Curricula	Froduct Development, Materials and Froduction. Specialist	alion Froduction. Liective Compulsory		



Course L1592: Applied Automation		
Тур	Problem-based Learning	
Hrs/wk	3	
СР	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		
Cycle	SoSe	
	-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 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
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
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. Bodo Fiedler
Language	EN
Cycle	WiSe
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
1.11	Hall Of an Island of the Island of the Organization of the Organization Hall on the Organization of the Or
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

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Course L0927: Elements of Integrat	ed 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 / U	Jser 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

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. Daniel Steffen
Language	DE
Cycle	SoSe
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development It systems for product development Establishment of management standards Typical types of organization
Literature	 Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Hausarbeit
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
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.

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



Course L0500: Joining of Polymer-M	Metal Lightweight Structures
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	WiSe
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 structure: used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications 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 and 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 lightweight 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
	 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 L0057: Design with Polymers and Composites	
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. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning
	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

	ation with Fibre Painfarend Bahmana Churchurd Machanica
	ction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture 2
Hrs/wk	2
CP Washing dia Harra	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale Lecturer	30 min Dr. Marco Schürg
	DE DE
Language	WiSe
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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.



Typ	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	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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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.
	 Turvey, G.J., Marshan, 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.

• Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.



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
	 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
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.

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 Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg



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
СР	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
Literature	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	
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	
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	
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping) 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) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and labrication process; Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magnetoresistance, AMR and GMR, fluxgate magnetometer) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, clark electrode, p
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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006.
Literature	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 LOCCA, Foodbook Control	Medical Technology
Course L0664: Feedback Control in Medical Technology	
	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
	Taking an engineering point of view, the lecture is structured as follows. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine 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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation 	
Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Heidelberg, 2007		

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



Course L1130: Six Sigma			
Тур	Lecture		
Hrs/wk	2		
СР	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		
Literature	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 A	Course L0855: System Analysis in Air Transportation		
Тур	Lecture		
Hrs/wk			
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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull		
Literature	Hand out		

Course L1513: Technical Design	course L1513: Technical Design		
Тур	ecture		
Hrs/wk			
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	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies		
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen		



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, 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		
Lecturer	Dr. Rolf Janßen		
Language	DE/EN		
Cycle	WiSe		
	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		
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing	
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	
СР	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		
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	 Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems 	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Module M1209: Selected To	opics of Product Development, Materials Science	ence 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
Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Composites (L		Lecture	2	3
Elements of Integrated Production System		Problem-based Learning	2	3
Emotional Design / User Centered Produc		Seminar	2	2
Development Management for Mechatron		Lecture	2	3
Design Optimization and Probabilistic App		Seminar	3	3
Fatigue & Damage Tolerance (L0310)	, , , , , , , , , , , , , , , , , , ,	Lecture	2	3
Joining of Polymer-Metal Lightweight Structure	etures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweight Structure		Laboratory Course	1	1
Design with Polymers and Composites (LC		Lecture	2	3
	rced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
	rced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Course (L12		Problem-based Learning	3	3
Mechanisms, Systems and Processes of		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
		Problem-based Learning	2	2
Productivity Management (L0928)			1	4
Productivity Management (L0931)	(1,0664)	Recitation Section (small)	2	3
Feedback Control in Medical Technology	(LU004)	Lecture	2	•
Renewable Energy (L0313)		Lecture		2
Renewable Energy (L1434)		Recitation Section (small)	1 2	1
Six Sigma (L1130)	055)	Lecture		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		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	Only one of the modules "Selected Topics of Product Deve Product Development, Materials Science and Production (All		Alternative A: 12 CF	P)" or "Selected Topics of
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part cuses stilly students have reached the follows	owing loarning regulte		
	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	Students are able to express their extended knowled	adae and discuss the connection of different	special fields or app	dication areas of produc
	Students are able to express their extended knowledge to the state of the stat	eage and discuss the connection of different	special lielus of app	nication areas or produc
	development, materials and production			
	Students are qualified to connect different special field	ds with each other		
Chille				
Skills	 Students can apply specialized solution strategies an 	nd new scientific methods in selected areas		
	Students are able to transfer learned skills to new and		ution approaches	
Personal Competence				
Social Competence -				
Autonomy				
Autonomy	 Students are able to develop their knowledge and ski 	ills 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: Specialisat	ion Product Development: Flective Compulsor	/	
Curricula	Product Development, Materials and Production: Specialisate		,	
Curricula				
	Product Development, Materials and Production: Specialisat	ion materials: Elective Compulsory		



Course L159	2: Applied Automation
Тур	
Hrs/wk	*
СР	
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
	-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 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
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
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. Bodo Fiedler
Language	EN
Cycle	WiSe
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
	Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press
	Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of Integrat	ed 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
СР	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 Management for Mechatronics		
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. Daniel Steffen	
Language	DE	
Cycle	SoSe	
Content	Processes and methods of product development - from idea to market launch identification of market and technology potentials development of a common product architecture Synchronized product development across all engineering disciplines product validation incl. customer view Steering and optimization of product development Design of processes for product development IT systems for product development Establishment of management standards Typical types of organization	
Literature	 Bender: Embedded Systems - qualitätsorientierte Entwicklung Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme 	



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Hausarbeit
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
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.

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



Course L0500: Joining of Polymer-Metal Lightweight Structures		
Typ	Lecture	
Hrs/wk	2	
СР	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	WiSe	
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 structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications 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 and 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 lightweight structures as well as their application fields.	
Literatura		
Literature	 Lecture Notes and selected papers J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International 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 L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning
	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

O	of the Polish Bolish and Bolish and District Marketine	
Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics		
Hrs/wk	Lecture 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	
	Dr. Marco Schürg	
Language	DE 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. 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. 	



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	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 st 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 ef 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 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., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.
	Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.
	Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. The Cold Market Hill Hand and a cold and the stability of consequence of the stability.
	Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition. Harshavish, C.T., Machanica of fibration composites", John Willow and Consults. New York, current edition.
	 Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.



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	
	 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 	
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996. R&G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009. VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund" Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005. 	

Course L0950: Mechanisms, System	
Тур	Lecture
Hrs/wk	2
СР	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 investigatio of part/materials deficiencies Stress-strain relationships Strain gauge application Visko elastic behavior Tensile test (strain hardening, necking, strain rate) Compression test, bending test, torsion test Crack growth upon static loading (J-Integral) Crack growth upon cyclic loading (micro- und macro cracks) Effect of notches Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) Wear testing Non destructive testing application for overhaul of jet engines
Literature	 E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg



Course L0514: Metallic Materials for	r Aircraft Applications
Тур	Lecture
Hrs/wk	2
СР	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
Literature	Introduction/process of aircraft design/various aircraft configurations Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) Statistical methods in overall aircraft design/data base methods Principles of aircraft performance design (stability, V-n-diagramme) Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) Principles of engine design and integration Cruise design Design of runway and landing field length Cabin design (fuselage dimensioning, cabin interior, loading systems) System- and equipment aspects Design variations and operating cost calculation J. Roskam: "Airplane Design"
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	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 Tech	nology
Тур	
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	 Introduction (historical view, scientific and economic relevance, scaling laws) Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) Eiching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with 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) Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SOREAM process, LIGA, SUB, rapid prototyping) 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) Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, apacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process; Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; principle of biosensor, Clark electrode, enzyme electrod
Literature	electroplating, 3D-MID) 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	 Principles of productivity management Shop floor management and standardisation Takt analysis and design of manual operations Maintenance Principles Total Productive Maintenance (TPM) Optimisation of set-up operations Analysis of interlinked production systems
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
СР	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

Typ L	Lecture
Hrs/wk 2	2
CP 3	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form N	Mündliche Prüfung
Examination duration and scale	
Lecturer U	Ulf Pilz, Prof. Olaf Simanski
Language [DE
Cycle S	SoSe
	Taking an engineering point of view, the lecture is structured as follows. Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
V	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
СР	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	 introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

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



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	
Literature	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	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull
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	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen



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 Perter Deslius Jacek Slaski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen 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 GmbH, 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		
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	Dr. Rolf Janßen	
Language	DE/EN	
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 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		
	Application and analysis of basic mechanical as well as non-destructive testing of materials Determination elastic constants Tensile test Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) Crack growth upon static loading (stress intensity factor, fracture toughness) Creep test Hardness test Charpy impact test Non destructive testing	
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	
СР	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	
	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	 Functions of reliability and safety (regulations, certification requirements) Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) Reliability analysis of electrical and mechanical systems 	
Literature	 CS 25.1309 SAE ARP 4754 SAE ARP 4761 	



Courses				
itle		Тур	Hrs/wk	СР
Computer and communication technology in cabin electronics and avionics (L1557)		Lecture	2	2
	in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
lodel-Based Systems Engineering (MBSI	e) with SysML/UML (L1551)	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			
	Province Installation in			
	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:			
	describe the structure and operation of computer architecture:			
	• explain the structure and operation of digital communication N			
	explain architectures of cabin electronics, integrated modular		ation Network (ADCN)
	• understand the approach of Model-Based Systems Engineeri	ng (MBSE) in the design of hardware and so	oftware-based cabin s	ystems
Skills	Students are able to:			
	understand, operate and maintain a Minicomputer			
	build up a network communication and communicate with oth			
	connect a minicomputer with a cabin management system (A			
	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:			
	organize and schedule their practical tasks			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
•	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following		Sective Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: I			
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	i roduction. Liective Compuisory		



Course L1557: Computer and communication 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	
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	- 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 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 (Generation from Wind and Hydro Power			
Courses				
Title		Тур	Hrs/wk	СР
Renewable Energy Projects in Emerged M	flarkets (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 following le	earning results		
Professional Competence		<u> </u>		
Knowledge				
	Through active discussions of various topics within the seminar theoretical background and are thus able to transfer what they have		e their understanding and	d the application of the
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 multidisc	plinary within a seminar.		
Autonomy	Students can independently exploit sources in the context of the er particular knowledge about the subject area.	nphasis of the lecture material to	clear the contents of the le	ecture and to acquire the
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: Elective Co	ompulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Con	npulsory		
	Energy and Environmental Engineering: Specialisation Energy Eng	neering: Elective Compulsory		
	International Management and Engineering: Specialisation II. Rene	wable Energy: Elective Compulsor	y	
	International Management and Engineering: Specialisation II. Energ	y and Environmental Engineering	: Elective Compulsory	
	Product Development, Materials and Production: Specialisation Pro	duct Development: Elective Comp	ulsory	
	Product Development, Materials and Production: Specialisation Pro	duction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials	erials: Elective Compulsory		
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process Engine	ering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environments	Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Elective	e Compulsory		



Course L0014: Renewable Energy F	Projects in Emerged Markets
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
	■ History
	Future markets
	Special challenges in new markets - Overview
	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	 Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice
Literature	 Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006



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	Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion
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	 Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy 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 Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion
Literature	 Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage



ourses				
le		Тур	Hrs/wk	СР
oply Chain Management (L1218)		Problem-based Learning	3	4
ue-Adding Networks (L1190)		Lecture	2	2
Module Responsible	Prof. Thorsten Blecker			
Admission Requirements	no			
Recommended Previous	no			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	arning results		
Professional Competence				
Knowledge	Current developments in international business activities such as of	utsourcing, offshoring, internationaliza	ation and globalization	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 theories fr	m institutional economics (transaction	n cost theory, principa	al-agent theory, prop
	right theory) and the resource-based view.			
	Selected approaches to explain the development of networks.			
	to illustrate phases of network formation.			
	to understand the functional mechanisms of inter-organizational and the surface and extension and the surface and the sur	d international network relationships.		
	to explain and categorize relationships within networks. to extraorize coursing expects and explain metions/harriers as as	ventages and disadventages		
	 to categorize sourcing concepts and explain motives/ barriers or ac advantages and disadvantages of offshoring and outsourcing and 	•	two torms	
	to state criteria/ factors/ parameters that influence production location			
	• to explain methods for location finding/evaluation.	Truecisions at the global level (total fle	stwork costs).	
	• to interpret phenotypes of production networks.			
	• recognize relationships between R & D and production and their lo	cations and to describe coherent mode	els.	
	• to solve sub-problems with the configuration of logistics networks (o			iate approaches.
	to categorise special waste logistics including their duties & objecti			
Skills	to asses trends and challenges in national and international supply		ir consequences for o	companies.
	to evaluate, analyse and systematise networks and network relation			
	• to analyse partners and their suitability for co-operation in collaboration			Latter describer on the
	to select sourcing concepts for specific products / product company	onents based on the lecture as well	as advantages and	disadvantages of e
	approach.	anaanta		
	 to evaluate location decisions for production and R & D based on c to recognize relationships between R & D and production as w 		the cuitability of ene	cific models for diffe
	situations.	in as their locations and to evaluate	the suitability of spe	cinc models for diffe
	to transfer the analyzed concepts to international practices.			
	to analyse and evaluate the product development processes.			
	• to analyse concepts of Information and communication manageme	nt in logistics.		
	• to design subcontracting, procurement, production and disposal as			
	• to plan reorganise efficient and flow-oriented enterprise networks.			
	• to adopt methods of complexity management and risk managemen	in logistics.		
Personal Competence				
Social Competence	to evaluate intercultural and international relationships based on di			
	advance planning and design of network formation and their object			
	definition of procurement strategies for individual parts using the gas decimal of the gas are stated as the same of the gas are stated as the gas are stated as the same of the gas are stated as the gas are			
	 design of the procurement network (external/internal/modules etc.) of the case studies. 	based on the sourcing concepts and t	core competencies, a	is well as on the lind
	to make decision of location for production taking into account	alphal contexts evaluation methods :	and huving/selling m	arkete which were
	discussed in the case studies and their dependence on R & D.	Jobai contexts, evaluation methods a	and buying/selling in	arkets, willer were
	Decision on R & D locations based on the insights gained from cas	e studies / practical examples and the	selection of an appro	priate model.
Autonomy	After completing the module students are capable to work indep	endently on the subject of Supply Ch	hain 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	no Managament Flaction Occurs		
Assignment for the Following	International Management and Engineering: Specialisation I. Electiv			
Curricula	Logistics, Infrastructure and Mobility: Specialisation Production and I		V.	
	Product Development, Materials and Production: Specialisation Product Development, Materials and Production: Specialisation Production:		у	
	. 100000 20 voiopinoni, materialo ana i roductioni opecialisationi Fiot	action. Licotive Compulsory		



	Duckless hazard agreeing
Typ	Problem-based Learning 3
Hrs/wk	4
Workload in Hours	
Lecturer	Independent Study Time 78, Study Time in Lecture 42 Prof. Wolfgang Kersten
Language	DE
Cycle	SoSe
Content	 Transmission of a profound understanding in logistics and supply chain management Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts to business cases Identification of trends and challenges in national and international supply chains Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push of pull-based strategies, efficiency vs. responsiveness) Elaboration of approaches and goals in the field of resource planning and supplier management Identification and analyzes of concepts in logistics management Implementation of the fields of purchasing, operations and sales into the business strategy Transmission of knowledge concerning demand management and distribution logistics Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods
Literature	Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin. Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 rd 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 Busines 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 ScoOverview.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	 Introduction: Overview of current trade flows and development of global business cooperation Networks explanations using neo institutional approaches as a theoretical basis Networks organization and functioning Development stages of networks Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics
Literature	 Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004. Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001. Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008. Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006. Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000. Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009. Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.



Madula M0620. Dahatias a	nd Navination in Madiaina			
Module M0630: Robotics a	nd Navigation in Medicine			
Courses				
Title		Тур	Hrs/wk	СР
Robotics and Navigation in Medicine (L033	35)	Lecture	2	3
Robotics and Navigation in Medicine (L033	38)	Project Seminar	2	2
Robotics and Navigation in Medicine (L033	36)	Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous				
Knowledge	principles of math (algebra, analysis/calculus)			
	 principles of programming, e.g., in Java or C++ 			
	solid R or Matlab skills			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking system	s in clinical contexts and illustrate systems an	d their components in	details. Systems can be
	evaluated with respect to collision detection and safety an	d regulations. Students can assess typical syst	ems regarding design a	and limitations.
Skills	The students are able to design and evaluate navigation s	vstems and robotic systems for medical applica	tions	
S.i.i.e	The state in the date to design and state in angularity	your and rosono systems for modical appropriate		
Personal Competence				
Social Competence	The students discuss the results of other groups, provide h	eloful feedback and can incorporate feedback	into their work	
Autonomy	The students can reflect their knowledge and document the	e results of their work. They can present the res	ults in an appropriate n	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 Engineering	g: Elective Compulsory		
Curricula	Electrical Engineering: Specialisation Medical Technology	: Elective Compulsory		
	Computational Science and Engineering: Specialisation S	ystems Engineering and Robotics: Elective Co	mpulsory	
	International Management and Engineering: Specialisation	n II. Electrical Engineering: Elective Compulsor	y	
	Mechatronics: Specialisation Intelligent Systems and Robo	tics: Elective Compulsory		
	Biomedical Engineering: Specialisation Artificial Organs a	nd Regenerative Medicine: Elective Compulsor	у	
	Biomedical Engineering: Specialisation Implants and Endo	pprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Technolo	gy and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Management and	Business Administration: Elective Compulsory		
	Product Development, Materials and Production: Specialis	ation Product Development: Elective Compulso	ory	
	Product Development, Materials and Production: Specialis	ation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialis	ation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Compleme			
	Theoretical Mechanical Engineering: Specialisation Bio- a	nd 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.



Course 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 Navigation 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
Content	See interlocking course
Literature	See interlocking course



Module M0764: Aircraft Sys	stems II			
0				
Courses		Ton	Heateds	O.D.
Title		Тур	Hrs/wk	CP
Aircraft Systems II (L0736) Aircraft Systems II (L0740)		Lecture Recitation Section (large)	3 2	4
Module Responsible	Prof. Frank Thielecke	rectiation decition (large)		2
Admission Requirements	None			
Recommended Previous	basic knowledge of:			
Knowledge	basic knowledge of.			
····o···ougo	mathematics			
	mechanics			
	thermo dynamics			
	• electronics			
	fluid technology			
	control technology			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students are able to			
	describe the structure of primary flight control systems	s as well as actuation-, avionic-, fuel- ar	nd landing gear-system	ns in general along with
	corresponding properties and applications.			
	 explain different configurations and designs and their or 	origins		
	 explain atmospheric conditions for icing such as the fun 	ctionality of anti-ice systems		
Skills	Students are able to			
	size primary flight control actuation systems			
	 perform a controller design process for the flight control 	actuators		
	design high-lift kinematics			
	 design and analyse landing gear systems 			
	design anti-ice systems			
Personal Competence				
Social Competence	Students are able to:			
coolai composino				
	Develop joint solutions in mixed teams			
Autonomy	Students are able to:			
	 derive requirements and perform appropriate yet simp 	lified design processes for aircraft system	is from complex issues	and circumstances in a
	self-reliant manner	,	·	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	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	Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation		ory	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation	n Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Sys	stems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementar	ry Course: 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	 Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) 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) 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) Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)
Literature	Moir, Seabridge: Aircraft Systems Torenbek: Synthesis of Subsonic Airplane Design Curry: Aircraft Landing Gear Design: Principles and Practices

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 M0811: Medical Ima	iging Systems			
Courses				
Title		Tun	Hrs/wk	CP
Medical Imaging Systems (L0819)		Typ Lecture	4	6
Module Responsible	Dr. Michael Grass	Lootaro		
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence		-		
Knowledge				
	Students can:			
	Describe the system configuration and components of the relationships and components of the relationships are supplied to the relationships and the relationships are supplied to the relationships and the relationships are supplied to the r	main clinical imaging eveteme:		
	Explain how the system components and the overall system.		n:	
	Explain and apply the physical processes that make imagin			
	Name and describe the physical effects required to genera		, , , , , , , , , , , , , , , , , , ,	
	Explain how spatial and temporal resolution can be influent	ced and how to characterize the	images generated;	
	Explain which image reconstruction methods are used to g	enerate images;		
	Describe and explain the main clinical uses of the different system	S.		
Skills	Students are able to:			
	 Explain the physical processes of images and assign to the 	systems the basic mathematica	l or physical equations required	i;
	 Calculate the parameters of imaging systems using 	the mathematical or physical eq	uations;	
	 Determine the influence of different system components on the spatial and temporal resolution of imaging systems; 			
	 Explain the importance of different imaging systems for a number of clinical applications; 			
	Select a suitable imaging system for an application.			
Personal Competence				
Social Competence	none			
Autonomy	Students can:			
	Understand which physical effects are used in medical ima	aina:		
	Decide independently for which clinical issue a measuring			
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: Elective	re Compulsory		
Curricula	Biomedical Engineering: Core qualification: Compulsory	and at December 19 19 19 19	and the second	
	Product Development, Materials and Production: Specialisation Product Development Meterials and Production: Specialisation Product Development	·	mpulsory	
	Product Development, Materials and Production: Specialisation Product Development, Materials and Production: Specialisation M			
	Theoretical Mechanical Engineering: Specialisation Bio- and Med		ulsory	
	Theoretical Mechanical Engineering: Specialisation Bio- and Med			
	The state of the s			

Course L0819: Medical Imaging Systems			
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:		
	. 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: Mechanical	Design Methodology			
Courses				
Title		Тур	Hrs/wk	СР
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	d the following learning results		
Professional Competence				
Knowledge	Science-based working on product design consider	ing targeted application of specific product design	echniques	
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.			cation of various product
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				
Assignment for the Following	International Management and Engineering: Specia	lisation II. Product Development and Production: E	lective Compulsory	
Curricula	Mechatronics: Specialisation System Design: Elective	ve Compulsory		
	Biomedical Engineering: Specialisation Artificial Org	gans and Regenerative Medicine: Elective Compul	sory	
	Biomedical Engineering: Specialisation Implants an	d Endoprostheses: Elective Compulsory		
	Biomedical Engineering: Specialisation Medical Ter	chnology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manageme	nt and Business Administration: Elective Compulso	ry	
	Product Development, Materials and Production: Sp	pecialisation Product Development: Elective Compu	ilsory	
	Product Development, Materials and Production: Sp	pecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Sp	pecialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Product Development and Production: Elective Co	mpulsory	
	Theoretical Mechanical Engineering: Technical Cor	mplementary Course: Elective Compulsory		

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



Course L1524: Mechanical Design N	Methodology
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	 Systematic reflection and analysis of the mechanical design process Process structuring in sections (task, functions, acting principles, design-elements and total construction) as well as levels (working-, controlling-, and deciding-levels) Creativity (basics, methods, practical application in mechatronics) Diverse methods applied as tools (function structure, GALFMOS, AEIOU method, GAMPFT, simulation tools, TRIZ) Evaluation and selection (technical-economical evaluation, preference matrix) Value analysis, cost-benefit analysis Low-noise design of technical products Project monitoring and leading (leading projects / employees, organisation in product development, creating ideas / responsibility and communication) Aesthetic product design (industrial design, colouring, specific examples / exercises)
Literature	 Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, KH.: Konstruktionslehre: Grundlage erfolgreicher Produktentwicklung, Methoden und Anwendung, 7. Auflage, Springer Verlag, Berlin 2007 VDI-Richtlinien: 2206; 2221ff



Module M1144: Manufactur	ing with Polymers and Composites - Fr	om Molecule to Part		
Courses				
Title		Тур	Hrs/wk	CP
Manufacturing with Polymers and Compos	ites (L0511)	Lecture	2	3
From Molecule to Composites Part (L1516		Problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	Non			
Recommended Previous	Structure and Properties of Polymers			
Knowledge	Structure and Properties of Composites			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes polymers and composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practical problems. They 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 Autonomy	Students are able to cooperate in small, mixed-sub engineering. They are able to effectively present and develop alternative approaches to an engineering prostudents are capable of independently solving mechatheir knowledge using the literature and other source pragmatically solve them by means of corresponding.	explain their results alone or in groups in front of oblem independently or in groups and discuss advanical engineering problems using provided literates provided by the supervisor. Furthermore, the	a qualified audience. St antages as well as draw ure. They are able to fill	udents have the ability to backs. gaps in as well as extent
		,		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	10		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	1,5 h	asking II Draduct Development and Books (1975)	antice Common to the	
Assignment for the Following	International Management and Engineering: Specialis	•	ective Compulsory	
Curricula	Materials Science: Specialisation Engineering Materia Mechanical Engineering and Management: Specialisa	· ·		
	Product Development, Materials and Production: Specialisa	• •	sorv	
	Product Development, Materials and Production: Spec	·	301 y	
	Product Development, Materials and Production: Spec	• •		
	Theoretical Mechanical Engineering: Specialisation M	· · ·		
	Theoretical Mechanical Engineering: Opecialisation in			
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Course L0511: Manufacturing with Polymers and 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	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining		
	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding		
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag		
	Crawford: Plastics engineering, Pergamon Press		
	Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag		
	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 M1145: Automation	and Simulation			
Courses				
Title Automation and Simulation (L1525) Automation and Simulation (L1527)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 3 3
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous	BSc Mechanical Engineering or similar			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	Students can describe the structure an the function of process programmable logic computers.		onents, the data trans	fer via bus systems an
	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	hed 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	Teamwork in small teams.			
Autonomy	Students are able to identify the need of methocic analysises in the field of automation systems, to do these analysisis in an adequate manner und to			
	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		<u> </u>	
Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Election	ve Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elect			
	International Management and Engineering: Specialisation II. Energia		ective Compulsory	
	International Management and Engineering: Specialisation II. Aviat			
	International Management and Engineering: Specialisation II. Prod	uct Development and Production: Elec	ctive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsory	ativa Camarulaan		
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elec		077	
	Product Development, Materials and Production: Specialisation Pro Product Development, Materials and Production: Specialisation Pro		Ury	
	Product Development, Materials and Production: Specialisation Materials and Production: Specialisation Ma			
	r roddor Development, materials and Froduction. Specialisation Ma	toriais. Liective Compuisory		



Course L1525: Automation and Simulation			
Тур	Lecture		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Günter Ackermann		
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	Prof. Günter Ackermann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1156: Systems E	ngineering			
Courses				
Fitle .		Тур	Hrs/wk	СР
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			
	*All Cabili Systems			
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to:			
	\bullet understand systems engineering process models, methods and	tools for the development of complex Sys	stems	
	describe innovation processes and the need for technology Mar	agement		
	\bullet explain the aircraft development process and the process of type	e certification for aircraft		
	• explain the system development process, including requirement	s for systems reliability		
	identify environmental conditions and test procedures for airborne Equipment			
	• value the methodology of requirements-based engineering (RB	E) and 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			
	assign required business activities and technical Tasks			
	apply systems engineering methods and tools			
Personal Competence				
Social Competence	Students are able to:			
oodai oonipalenda	 understand their responsibilities within a development team and 	integrate themselves with their role in the	e overall process	
	and and the responsionade within a development team and		5 5.01411 p100000	
Autonomy	Students are able to:			
	• interact and communicate in a development team which has dis	ributed 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: Compulsory			
Curricula	International Management and Engineering: Specialisation II. Avi	ation Systems: Elective Compulsory		
	International Management and Engineering: Specialisation II. Pro	duct Development and Production: Electi	ve Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsor	у		
	Mechatronics: Specialisation Intelligent Systems and Robotics: El			
	Product Development, Materials and Production: Specialisation F			
	Product Development, Materials and Production: Specialisation F			
	Product Development, Materials and Production: Specialisation N			



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 Engineering		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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	ninery			
0.000				
Courses		_		
Title		Тур	Hrs/wk	CP
Turbomachines (L1562) Turbomachines (L1563)		Lecture	3 1	4
	Dut Face Los	Recitation Section (large)	ı	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	resuits		
Professional Competence				
Knowledge	The students can			
	 distinguish the physical phenomena of conversion of energy, 			
	 understand the different mathematic modelling of turbomachinery, 			
	calculate and evaluate turbomachinery.			
Skills	The students are able to			
	- understand the physics of Turbomachinery,			
	- solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to			
	discuss in small groups and develop an approach.			
Autonomy	The students are able to			
	develop a complex problem self-consistent,			
	analyse the results in a critical way,			
	have an qualified 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			
	Product Development, Materials and Production: Specialisation Product De	evelopment: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production	: 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:
Literature	 Application cases of turbomachinery Fundamentals of thermodynamics and fluid mechanics Design fundamentals of turbomachinery Introduction to the theory of turbine stage Design and operation of the turbocompressor Design and operation of the steam turbine Design and operation of the gas turbine Physical limits of the turbomachines
Literature	 Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York Menny: Strömungsmaschinen, Teubner., Stuttgart



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	СР
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	e following learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of polymeric, semiconductor, modern composite materials		lications in technology, in part	icular metallic, ceramic,
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to develop ideas further.			
Autonomy	The students are able to			
	 assess their own strengths and weaknesses. 			
	define tasks independently.			
Workload in Hours	Independent Study Time 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: Specia	alisation Product Development: Elective Co	ompulsory	
	Product Development, Materials and Production: Specia	alisation Production: Elective Compulsory		
	Product Development, Materials and Production: Specia	alisation Materials: Compulsory		
	Theoretical Mechanical Engineering: Specialisation Ma	terials Science: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Comple	mentary 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	 Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry) 		
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: Mechanical	Properties			
Courses				
Title		Тур	Hrs/wk	СР
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 reach	ed the following learning results		
Professional Competence				
Knowledge	Students can explain basic principles of crystall	lography, statics (free body diagrams, tractions) and	d thermodynamics (ener	gy minimization, energy
	barriers, entropy)			
OL III.	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Skills	Students are capable of using standardized calcul	lation methods: tensor calculations, derivatives, integr	als, tensor transformation	18
Personal Competence				
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.			
4.4				
Autonomy	Students are able to			
	- assess their own strengths and weaknesses			
	- assess their own state of learning in specific term	ns and to define further work steps on this basis guide	d by teachers.	
	and to decree death to see death and a second and a	the self-resolution and the self-resolution and a 26 self-resolution	b d . d	
	- work independently based on lectures and notes	s to solve problems, and to ask for help or clarifications	s wnen needed	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Materials Science: Core qualification: Compulsory	1		
Curricula	Mechanical Engineering and Management: Speci	alisation Materials: Elective Compulsory		
	Product Development, Materials and Production: S	Specialisation Product Development: Elective Compu	Isory	
	Product Development, Materials and Production: S	Specialisation Production: Elective Compulsory		
	Product Development, Materials and Production: S	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			
	ughening mechanisms: crack bridging, fibres			
	erogeneous materials III			
	ughening 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	d Robust Control				
Courses					
Title		Тур	Hrs/wk	СР	
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	Control Systems Theory and Design				
Recommended Previous					
Knowledge	Classical control (frequency response, root locus Chate an any markeds	5)			
	State space methods Linear algebra, singular value decomposition				
	- Linear algebra, singular value decomposition				
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence					
Knowledge	Students can explain the significance of the matr	iv Riccati equation for the solution of LO problems			
	They can explain the duality between optimal star				
		is are used to represent stability and performance	constraints		
		an be formulated as special case of an H2 design p			
		represented in a way that lends itself to robust con			
	They can explain how - based on the small gain	theorem - a robust controller can guarantee stabilit	y and performance fo	r an uncertain plant.	
	They understand how analysis and synthesis con	nditions on feedback loops can be represented as	linear matrix inequali	ties.	
01.111-					
Skills	Students are capable of designing and tuning LC	QG controllers for multivariable plant models.			
	They are capable of representing a H2 or H-infi	nity design problem in the form of a generalized	plant, and of using st	andard software tools f	
	solving it.				
	They are capable of translating time and frequent	ency domain specifications for control loops into co	specifications for control loops into constraints on closed-loop sensitivity functions,		
	and of carrying out a mixed-sensitivity design.	sitivity design.			
	They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller.				
	They are capable of formulating analysis and a	synthesis conditions as linear matrix inequalities	(LMI), and of using	standard LMI-solvers for	
	solving them.				
	They can carry out all of the above using standar	rd software 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	s provided (lecture notes, literature, software docum	nentation) and use it t	o solve given problems.	
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 Engineer	ing: Elective Compulsory			
Curricula	Electrical Engineering: Specialisation Control and Power				
	Energy Systems: Core qualification: Elective Compulsor	у			
	Aircraft Systems Engineering: Specialisation Aircraft Sys	stems: Elective Compulsory			
	Computational Science and Engineering: Specialisation	Systems Engineering and Robotics: Elective Com	pulsory		
	Mechatronics: Specialisation System Design: Elective C	ompulsory			
	Mechatronics: Specialisation Intelligent Systems and Ro	botics: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs				
	Biomedical Engineering: Specialisation Implants and Er				
	Biomedical Engineering: Specialisation Medical Technology				
	Biomedical Engineering: Specialisation Management at				
	Product Development, Materials and Production: Specia	·	У		
	Product Development, Materials and Production: Specia				
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory				
	Theoretical Mechanical Engineering: Core qualification: Theoretical Mechanical Engineering: Technical Comple				
	moore and meeting incar Engineering. Technical Comple	montary Course. Elective Compulsory			



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

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	



Courses				
Courses				
Title		Тур	Hrs/wk	CP
Robotics: Modelling and Control (L0168)		Lecture	3	3
Robotics: Modelling and Control (L1305)		Recitation Section (small)	2	3
	Prof. Uwe Weltin			
Admission Requirements				
	Fundamentals of electrical engineering			
Knowledge B	Broad knowledge of mechanics			
F	Fundamentals of control theory			
Educational Objectives A	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge S	Students are able to describe fundamental properties of robots a	and solution approaches for multiple problem	ms in robotics.	
Skills S	Students are able to derive and solve equations of motion for va	rious manipulators.		
S	Students can generate trajectories in various coordinate system	S.		
S	Students can design linear and partially nonlinear controllers for	robotic manipulators.		
Personal Competence				
Social Competence S	Students are able to work goal-oriented in small mixed groups.			
Autonomy S	Students are able to recognize and improve knowledge deficits	ndependently.		
v	With instructor assistance, students are able to evaluate their ow	n knowledge level and define a further cou	rse of study.	
Workload in Hours In	Independent Study Time 110, Study Time in Lecture 70			
Credit points 6	6			
Examination V	Written exam			
Examination duration and scale 1	120 min			
Assignment for the Following C	Computer Science: Specialisation Intelligence Engineering: Ele	ctive Compulsory		
	Computational Science and Engineering: Specialisation System		oulsory	
Ir	International Production Management: Specialisation Production	n Technology: Elective Compulsory		
Ir	International Management and Engineering: Specialisation II. M	echatronics: Elective Compulsory		
Ir	International Management and Engineering: Specialisation II. Pr	oduct Development and Production: Electiv	e Compulsory	
	Mechanical Engineering and Management: Core qualification: C			
N	Mechatronics: Core qualification: Compulsory			
P	Product Development, Materials and Production: Specialisation	Product Development: Elective Compulsory	/	
P	Product Development, Materials and Production: Specialisation	Production: Elective Compulsory		
P	Product Development, Materials and Production: Specialisation	Materials: Elective Compulsory		
Т	Theoretical Mechanical Engineering: Specialisation Product De	velopment and Production: Elective Compu	Isory	
Т	Theoretical Mechanical Engineering: Technical Complementary	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		
	ajectory 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 M0719: Biomaterial	s and Regenerative Medicine			
Courses				
Title		Тур	Hrs/wk	СР
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 implants and endop	rotheses are recommended.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge	The students can describe the material characteristics of materials	used in medical engineering, including	ng their advantages and	disadvantages.
	The students can name the polymers, metals and synthetic materia	s used in humans.		
	The student has a basic understanding on issues of regenerative m	edicine.		
Skills	The students can explain the advantages and disadvantages of the	materials used in medical engineeri	ing.	
	The student can explain and describe the basic principles of cell use for regenerative medical applications.			
	The student can use literature databases for accumulation and pres	entation of relevant up-to-date data.		
Personal Competence				
Social Competence	The student can lead discussions and participate in them, represent	ting work results.		
	The student can respectfully and adequately work in a team with his	s peers.		
Autonomy	The student has the ability to acquire knowledge independently and	d transfer the acquired knowledge to	new issues.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, between 20 and 50 questions			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess En	gineering: Elective Compulsory		
Curricula	International Management and Engineering: Specialisation II. Proceedings	ess Engineering and Biotechnology:	Elective Compulsory	
	Product Development, Materials and Production: Specialisation Production	duct Development: Elective Compul	sory	
	Product Development, Materials and Production: Specialisation Production	duction: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Ma			
	Theoretical Mechanical Engineering: Technical Complementary Co	urse: Elective Compulsory		



Course L0593: Biomaterials	
Тур	Lecture
Hrs/wk	2
CP Workland in Hause	3 Independent Chala. Time CO. Chala. Time in Leadure CO.
Workload in Hours Lecturer	Independent Study Time 62, Study Time in Lecture 28 Prof. Michael Morlock
Language	EN EN
Cycle	WiSe
Content	Topics to be covered include:
	Introduction (Importance, nomenclature, relations)
	2. Biological materials
	2.1 Basics (components, testing methods)
	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 Intervertebral discs
	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, properties, reaction of the body)
	4.3 Titan (alloys, properties, reaction of the body)
	4.4 Ceramics and glas (properties, reaction of the body)
	4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)
	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.
	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.
	Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.
	Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.
	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	WiSe
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 Handschel
	(Herausgeber), Hans Peter Wiesmann (Herausgeber): Springer, Berlin; ISBN-10: 3540777547; ISBN-13: 978-3540777540



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	Mathematics			
	Mathematics Mechanics			
	Thermodynamics			
	Aviation			
	Aviation			
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
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: Co	mpulsory		
Curricula	International Management and Engineering: Specia	lisation II. Aviation Systems: Elective Compulsory		
	Product Development, Materials and Production: Sp	ecialisation Product Development: Elective Compuls	ory	
	Product Development, Materials and Production: Sp	ecialisation Production: Elective Compulsory		
	Product Development, Materials and Production: Sp	ecialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Aircraft Systems Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Con	nplementary 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	
Language	DE	
Cycle	WiSe	
Content	 Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers) 	
Literature	Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II Etkin, B.: Dynamics of Atmospheric Flight Sachs/Hafer: Flugmechanik Brockhaus: Flugregelung J.D. Anderson: Introduction to flight	



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	 stationary asymmetric flight dynamics of lateral movement methods of flight simulation eyperimental methods of flight mechanics model validation using system identification wind tunnel techniques
Literature	 Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II Etkin, B.: Dynamics of Atmospheric Flight Sachs/Hafer: Flugmechanik Brockhaus: Flugregelung J.D. Anderson: Introduction to flight

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				
		Tue	Hundade	O.D.
Title		Typ	Hrs/wk 3	CP
Product Planning (L0851) Product Planning Seminar (L0853)		Problem-based Learning Problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt	Trobion Sacou Lourning		
Admission Requirements	None			
Recommended Previous	Good basic-knowledge of Business Administration			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning re	esults		
Professional Competence	, , , , , , , , , , , , , , , , , , ,			
Knowledge	Students will gain insights into:			
G				
	Product Planning			
	o Process			
	Methods			
	Design thinking			
	Process			
	Methods			
	 User integration 			
Skills	Students will gain deep insights into:			
	Product Planning			
	 Process-related aspects 			
	 Organisational-related aspects 			
	 Human-Ressource related aspects 			
	 Working-tools, methods and instruments 			
	0			
Personal Competence				
Social Competence				
	Interact within a team			
	Raise awareness for globabl issues			
Autonomy				
	Gain access to knowledge sources			
	Interpret complex cases			
	Develop presentation skills			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6	<u> </u>		
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. Electives Mana	agement: Elective Compulsory		
	Mechanical Engineering and Management: Specialisation Management: Ele	ective Compulsory		
	Product Development, Materials and Production: Specialisation Product Dev	elopment: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production:	Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials: El	lective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Product Development a		sory	
	Theoretical Mechanical Engineering: Technical Complementary Course: Ele	ective 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 Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment Transferring ideas for innovation into feasible concepts which have a high market attractively	
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 independently
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	ment (L0387)	Lecture	2	3
Health, Safety and Environmental Manage		Recitation Section (small)	1	1
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous				
Knowledge	Good knowledge in Technologies for Environmental Pro			
	Good knowledge of the relevant Environmental Legislati			
	Basic knowledge of instruments for Environmental Asses	ssment		
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students are able to describe the basics of regulations, e	conomic instruments, voluntary initiatives	, fundamentals of HS	E legislation ISO 14001
	EMAS and Responsible Care ISO 14001 requirements. They ca	n analyse and discuss industrial processe	s, substance cycles a	nd approaches from end-
	of-pipe technology to eco-efficiency and eco-effectiveness, show	ving their sound knowledge of complex inc	lustry related problem	s. They are able to judge
	environmental issues and to widely consider, apply or carry out	innovative technical solutions, remediation	measures and furthe	r interventions as well a
	conceptual problem solving approaches in the full range of prob	lems in different industrial sectors.		
Skills	Students are able to assess current problems and situations in	the field of environmental protection. The	ey can consider the b	est available techniques
	and to plan and suggest concrete actions in a company- or bran	ch-specific context. By this means they can	n 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 themse	lves for presentations and contributions to	the discussions. They	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	90 min	The state of the s		
Assignment for the Following	Energy and Environmental Engineering: Specialisation Environmental	mental Engineering: Elective Compulsory		
Curricula	Environmental Engineering: Core qualification: Compulsory Joint European Master in Environmental Studies - Cities and Su	etainability: Specialization Water: Elective	Compulsory	
	Joint European Master in Environmental Studies - Cities and Su Joint European Master in Environmental Studies - Cities and Su			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation Product Development, Materials and Production: Specialisation		y	
	Product Development, Materials and Production: Specialisation Product Development, Materials and Production: Specialisation			
	Water and Environmental Engineering: Specialisation Environm			
	Water and Environmental Engineering: Specialisation Environmental Engineering: Specialisation Cities: Co			
	Trator and Environmental Engineering, Specialisation Cities, CC	niipaiooi y		



Course L0502: Integrated Pollution	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 Case Studies: paper industry, cement industry, automotive industry Field Trip 		
Literature	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	Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives 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 Crisis management
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 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



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Courses				
Title		Тур	Hrs/wk	CP
The Digital Enterprise (L0932)		Lecture Lecture	2	2
Production Planning and Control (L0929) 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 Manag	gement		
Knowledge	, ,			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module	e in detail and take a critical position to them.		
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.			
Personal Competence	3 3			
Social Competence	Students can develop joint solutions in mixed te	ams and present them to others.		
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following		ecialisation II. Product Development and Production: Ele-	ctive Compulsory	
Curricula		tion Production and Logistics: Elective Compulsory	save compansory	
		l Organs and Regenerative Medicine: Elective Compulso	rv	
	Biomedical Engineering: Specialisation Implant			
	Biomedical Engineering: Specialisation Medica	I Technology and Control Theory: Elective Compulsory		
	Biomedical Engineering: Specialisation Manage	ement and Business Administration: Compulsory		
	Product Development, Materials and Production	n: Specialisation Product Development: Elective Compuls	ory	
	Product Development, Materials and Production	n: Specialisation Production: Compulsory		
	Product Development, Materials and Production	n: Specialisation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisa	ation Product Development and Production: Elective Com	pulsory	
	Theoretical Mechanical Engineering: Technical	Complementary Course: Elective Compulsory		

Course L0932: The Digital Enterpris	е
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	Modelling of business processes and data, simulation Knowledge and competence management Process management (MRP, workflow management) Computer Aided Planning (CAP) Virtual Reality (VR) and Augmented Reality (AR) Computer Aided Quality Management (CAQ) E-Collaboration
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	Models of Production and Inventory Management Production Programme Planning and Lot Sizing Order and Capacity Scheduling Selected Strategies of PPC Manufacturing Control Production Controlling Supply Chain Management	
Literature	 Vorlesungsskript Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002 	

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 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	СР
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 follow	wing learning results		
Professional Competence				
Knowledge	Students are able to describe single techniques and to giv	e an overview for the field of safety	and risk assessment as well	as environmental and
	sustainable engineering, in detail:			
	basics in safety and reliability of technical facilities			
	safety and reliability analysis methods			
	risk assessment			
	Production and usage of bio-char			
	energy production and supply			
	sustainable product design			
Skills	Students are able apply interdisciplinary system-oriented modests for processes and select economically feasible treatment		inability reporting. They can	evaluate the effort and
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from giver	sources and transform it to new que	stions. Furthermore, they car	define targets for new
	application or research-oriented duties in for risk manageme impact.	nt and sustainability concepts accorda	ance with the potential social	, economic and cultural
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 Compulsor	у	
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation	on Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation			
	Water and Environmental Engineering: Core qualification: Co	mpulsory		
	<u> </u>			

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	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations	
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf	



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 M1024: Methods of	Integrated Product Development			
Courses				
Title		Тур	Hrs/wk	CP
Integrated Product Development II (L1254		Lecture	3	3
Integrated Product Development II (L1254		Problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause	3		-
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	learning results		
Professional Competence				
Knowledge	After passing the module students are able to:			
	 explain technical terms of design methodology, 			
	 describe essential elements of construction management, 			
	describe essential elements of constitution management, describe current problems and the current state of research	of integrated product development		
	december can only problems and the carrent state of recountry	. or integrated product dovelopment		
Skills	After passing the module students are able to:			
	 select and apply proper construction methods for non-stand 	dardized solutions of problems as well	as adapt new boundar	v conditions.
	solve product development problems with the assistance o	•		, ,
	 choose and execute appropriate moderation techniques. 			
Personal Competence				
Social Competence	After passing the module students are able to:			
	 prepare and lead team meetings and moderation processe 	es,		
	 work in teams on complex tasks, 			
	 represent problems and solutions and advance ideas. 			
Autonomy	After passing the module students are able to:			
,				
	 give a structured feedback and accept a critical feedback, 			
	 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: Elect	tive Compulsory		
Curricula	Aircraft Systems Engineering: Specialisation Air Transportation Sy	stems: Elective Compulsory		
	International Management and Engineering: Specialisation II. Production	duct Development and Production: Ele	ctive Compulsory	
	Mechatronics: Specialisation System Design: Elective Compulsory	1		
	Product Development, Materials and Production: Specialisation Pr	roduct Development: Compulsory		
	Product Development, Materials and Production: Specialisation Pr			
	Product Development, Materials and Production: Specialisation Materials			
	Theoretical Mechanical Engineering: Specialisation Product Deve		pulsory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		



Course L1254: Integrated Product D	evelopment II
Тур	Lecture
Hrs/wk	3
СР	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, Adapted QFD matrix,
	Systematic material selection, Accombly griented design.
	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, Tablesia I Curally Obside Management
	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 management 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	
	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. Ask M.F. May also Scientist in Mayberian Design Mindows 2007. Ask M.F. May also Scientist in Mayberian Design Mindows 2007. Ask M.F. May also Scientist in Mayberian Design Mindows 2007.
	Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007. Real/mann, H.: Synnly Chain Management, Bodin, Springer 2004.
	 Beckmann, H.: Supply Chain Management, Berlin, Springer 2004. Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz
	Hartmann, M., Rieger, M., Funk, R., Rain, O.: Zieigenchiet moderieren. Ein Handouch für Funrungskralle, Berater und Trainer, Weinneim, Beitz 2007.
	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 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 M1002: Production	and Logistics Management			
Courses				
Title		Тур	Hrs/wk	CP
Operative Production and Logistics Manag	gement (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 will be distributed during the admission process.	participation in this module is accessable v	ia e-learning. Log-in a	nd additional information
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	Students will be able			
	- to differentiate between strategic and operational productio	n and logistics management,		
	- to describe the areas of production and logistics management	ent,		
	- understand the difference between traditional and new con	cepts of production planning and control,		
	- to describe and explain the actual challenges of production	and logistics management, esp. in an inter-	national context.	
Skilla				
Skills	Based on the cognized knowledge students are concluded			
	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			
	Selecting appropriate methods of production and logistics r		hlems	
	Making a holistic assessment of areas of decision in product			
Personal Competence	making a noncic accessment of a code of accessment product		it illiadrido ladioro.	
Social Competence	After completion of the module students can			
estal composition	- lead discussions and team sessions,			
	- arrive at work results in groups and document them,			
	- develop joint solutions in mixed teams and present them to	others.		
	- 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	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	n: Compulsory		
Curricula	Logistics, Infrastructure and Mobility: Core qualification: Comp	ulsory		
	Product Development, Materials and Production: Specialisatio	n Product Development: Elective Compulse	ory	
	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
СР	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
	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



Course L1089: Strategic Production	and Logistics Management
Тур	
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Kersten
Language	DE Wee-
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 strategy, 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 lean
	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: 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 M1025: Fluidics				
Courses				
Title		Тур	Hrs/wk	СР
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Problem-based Learning	1	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, hy	ydrostatics, kinematics and kinetics), fluid me	echanics, and enginee	ering 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			
	explain structures and functionalities of hydrostatic, pne	eumatic, and hydrodynamic components,		
	explain the interaction of hydraulic components in hydraulic components.	raulic systems,		
	 explain open and closed loop control of hydraulic syste 	ems,		
	 describe functioning and applications of hydrodynami 	ic torque converters, brakes and clutches as	s well as centrifugal p	umps and aggregates
	plant technology			
Chille	After a conjugat the property of the state o			
Skills	After passing the module students are able to			
	analyse and assess hydraulic and pneumatic compone	ents and systems,		
	1			
	perform numerical simulations of hydraulic systems based on abstract problem definitions,			
	select and adapt pump characteristic curves for hydraulic systems			
	 select and adapt pump characteristic curves for hydraulic systems dimension hydrodynamic torque converters and brakes for mechanical aggregates. 			
	umension nyurouynamic lorque conveners and brake.	o to mechanica 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			
	obtain necessary knowledge for the simulation.			
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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	International Management and Engineering: Specialisation II.			
Curricula	International Management and Engineering: Specialisation II.	Product Development and Production: Elect	ive Compulsory	
	Product Development, Materials and Production: Specialisation	on Product Development: Compulsory		
	Product Development, Materials and Production: Specialisation	on Production: Elective Compulsory		
	Product Development, Materials and Production: Specialisation	on Materials: Elective Compulsory		
		' '		
ĺ	Theoretical Mechanical Engineering: Specialisation Product D	Development and Production: Elective Comp	ulsory	



Course 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 centrifugal pumps
	creating and reading of characteristic curves of pumps and systems
	Field trip
	field trip to a regional company from the hydraulic industry.
	lieto trip to a regional company from the hydrautic moustry.
	Exercise
	Numerical simulation of hydrostatic systems
	getting to know a numerical simulation environment for hydraulic systems
	transformation of a task into a simulation model dimulation of common components.
	simulation of common components variation of simulation parameters
	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
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006
	Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006
	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



Module M1155: Aircraft Cal	bin 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 following learning	ı results		
Professional Competence				
Knowledge	Students are able to:			
	describe cabin operations, equipment in the cabin and cabin Systems			
	• explain the functional and non-functional requirements for cabin Systems			
	elucidate the necessity of cabin operating systems and emergency System	ms		
	assess the challenges human factors integration in a cabin environment			
Skills	Students are able to:			
	design a cabin layout for a given business model of an Airline			
	design cabin systems for safe operations			
	design emergency systems for safe man-machine interaction			
	solve comfort needs and entertainment requirements in the cabin			
Personal Competence				
Social Competence	Students are able to:			
	• understand existing system solutions and discuss their ideas with experts	3		
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 Compulsory			
Curricula	Aircraft Systems Engineering: Core qualification: Compulsory			
	International Management and Engineering: Specialisation II. Aviation Sys	tems: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Product De	evelopment: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Production	n: Elective Compulsory		
	Product Development, Materials and Production: Specialisation Materials:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engir	neering: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Complementary Course: E	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	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, CC., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006

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 M1183: Laser syste	ems and methods of manufacturing desig	n and analysis		
Courses				
Title		Тур	Hrs/wk	СР
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	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	isation Product Development: Elective Co	mpulsory	
Curricula	Product Development, Materials and Production: Specia	isation Production: Compulsory		
	Product Development, Materials and Production: Specia	isation Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Production	duct Development and Production: Elective	e Compulsory	
	Theoretical Mechanical Engineering: Technical Complete	mentary Course: Elective Compulsory		

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



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	Modelling and simulation of maching and forming processes Numerical simulation of forces, temperatures, deformation in machining Analysis of vibration problems in maching (chatter, modal analysis,) Knowledge based process planning Design of experiments Machinability of nonmetallic materials Analysis of interaction between maching process and machine tool systems with regard to process stability and quality Simulation of maching processes by virtual reality methods
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 M1174: Automation	n Technology and Systems			
Courses				
Title		Тур	Hrs/wk	CP
Handling and Assembly Systems (L1591)		Lecture	2	2
Handling and Assembly Systems (L1738)		Recitation Section (small)	1	1
Automation 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				
Educational Objectives	After taking part successfully, students have reached the following learning	g results		
Professional Competence				
Knowledge	Students			
	know the characteristic company of a substantial subst	I have good understanding of the late	raction	
	know the characteristic components of an automation systems and		eraction	
	know methods for a systematical analysis of automation tasks and			
	 have special competences in industrial robot based automation sy 	rstems		
Skills	Students are able to			
	analyze complex Automation tasks			
	develop application based concepts and solutions			
	design subsystems and integrate into one system			
	investigate and evaluate safety of machinery			
	 create simple programs for robots and programmable logic control 	llers		
	design of circuit for pneumatic applications			
Personal Competence				
Social Competence	Students are able to			
	- find solutions for automation and handling tasks in groups			
	- develop solutions in a production environment with qualified personnel	at technical level and represent decision	ons.	
Autonomy	Students are able to			
	analyze automation tasks independently			
	generate programs for robots and programmable logic devices au	tonomously		
	develop solutions for practice oriented tasks of automation indepe			
	design safety concepts for automation applications	•		
	assess consequences of their professional actions and responsible	ilities		
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	Product Development, Materials and Production: Specialisation Product D	Development: Elective Compulsory		
Curricula	Product Development, Materials and Production: Specialisation Production	on: Compulsory		
	Product Development, Materials and Production: Specialisation Materials			
	Theoretical Mechanical Engineering: Specialisation Product Developmen	nt and Production: Elective Compulsor	y	
	Theoretical Mechanical Engineering: Technical Complementary Course:	Elective Compulsory		



Course L1	Course L1591: Handling and Assembly Systems		
Тур	Lecture		
Hrs/wk	2		
СР	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		

Course L1738: Handling and Assembly Systems	
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	
Literature	

Course L1	590: Automation Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload	Independent Study Time 32, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Introduction to the production Automation including their different fields of application, importent terms, automation history and upcoming trends -Overview of different actuator concepts and their principles -Design of pneumatic wiring diagrams -Energyefficency in the production -Review of automatic identification systems like Barcode and RFID -Overview of the structure, components and algorithms of an image processing system -Introduction to buscommunication an the different general concepts -Comparision of Programmable logic controllers and hard-wired programmed logic controllers including the upcoming trends
Literature	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
	Hans-Jürgen Gevatter, Ulrich Grünhaupt: Handbuch der Mess- und Automatisierungstechnik in der Produktion



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	



Thesis

Module M-002: Master Thes	sis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	
	According to General Regulations §24 (1):
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can 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 current
	developments and taking up a critical position on them.
	The students can place a research task in their subject area in its context and describe and critically assess the state of research.
···	
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 defined
	problems in a solution-oriented way.
	 To develop new scientific findings in their subject area and subject them to a critical assessment.
Personal Competence	
Social Competence	Students can
	Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.
	Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their
	own assessments and viewpoints convincingly.
Autonomy	Students are able:
	To structure a project of their own in work packages and to work them off accordingly.
	To work their way in depth into a largely unknown subject and to access the information required for them to do so.
	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	according to Subject Specific Regulations
Examination duration and scale	
0	Civil Engineering: Thesis: Compulsory
Curricula	Bioprocess Engineering: Thesis: Compulsory 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
	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 Repoweble Francisc: Thesis: Compulsory
	Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory
	Ship and Offshore Technology: Thesis: Compulsory
	Theoretical Mechanical Engineering: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory
	Water and Environmental Engineering: Thesis: Compulsory

