Module Manual

Master of Science (M.Sc.)

Product Development, Materials and Production

Cohort: Winter Term 2018 Updated: 30th April 2020

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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).

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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 Responsible Prof. Matthias Meyer Admission Requirements None Recommended Previous Knowledge None Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence After taking part successfully, students have reached the following learning results Professional Competence • Knowledge • Students are able to find their way around selected special areas of management within th 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 apply basic methods in selected areas of business management. • Students are able to apply basic methods in selected areas of business management. • Students are able to explain and give reasons for decision proposals on practical issues in area of business management. Personal Competence • Social Competence • Autonomy • • Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material. Workload in Hours Depends on choice of courses	Module M0523: B	usiness & Management
Admission Requirements None Recommended Previous Knowledge None Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence After taking part successfully, students have reached the following learning results Professional Competence • Students are able to find their way around selected special areas of management within th scope of business management. Knowledge • 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. • Students are able to apply basic methods in selected areas of business management. Skills • Students are able to explain and give reasons for decision proposals on practical issues in area of business management. Personal Competence • Students are able to communicate in small interdisciplinary groups and to jointly develor solutions for complex problems Autonomy • Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material.	Module Responsible	Prof. Matthias Meyer
Recommended Previous Knowledge None Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence 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. Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in area of business management. Students are able to communicate in small interdisciplinary groups and to jointly develor solutions for complex problems Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material.	Admission Requirements	None
Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Students are able to find their way around selected special areas of management within th 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. Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in area of business management. Students are able to communicate in small interdisciplinary groups and to jointly develor solutions for complex problems Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material. Workload in Hours Depends on choice of courses 	Recommended Previous Knowledge	None
Professional Competence Image: Students are able to find their way around selected special areas of management within the scope of business management. Image: Students are able to explain basic theories, categories, and models in selected special areas of business management. Image: Students are able to apply basic methods in selected areas of business management. Image: Skills Image: Skills <	Educational Objectives	After taking part successfully, students have reached the following learning results
Knowledge • 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. * Students are able to apply basic methods in selected areas of business management. • Students are able to apply basic methods in selected areas of business management. • Students are able to explain and give reasons for decision proposals on practical issues in area of business management. • Students are able to communicate in small interdisciplinary groups and to jointly develor solutions for complex problems • Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material. Workload in Hours Depends on choice of courses	Professional Competence	
 Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in area of business management. Personal Competence Social Competence Students are able to communicate in small interdisciplinary groups and to jointly develous solutions for complex problems Students are capable of acquiring necessary knowledge independently by means of research are preparation of material. Workload in Hours Depends on choice of courses	Knowledge	 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 or business management. Students are able to interrelate technical and management knowledge.
Personal Competence Social Competence Social Competence • Students are able to communicate in small interdisciplinary groups and to jointly development solutions for complex problems Autonomy • Students are capable of acquiring necessary knowledge independently by means of research are preparation of material. Workload in Hours Depends on choice of courses	Skills	 Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.
Social Competence • Students are able to communicate in small interdisciplinary groups and to jointly development in solutions for complex problems Autonomy • Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material. Workload in Hours Depends on choice of courses	Personal Competence	
Students are capable of acquiring necessary knowledge independently by means of research ar preparation of material. Workload in Hours Depends on choice of courses	Social Competence	 Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems
Workload in Hours Depends on choice of courses	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	Credit points	6

Courses

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

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Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended	None
Previous Knowledge	After taking part successfully, students have reached the following learning results
Professional	
Competence	The Newbook size (Academic Deservements (NTA)
	are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles".
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.
	Fields of Teaching
Knowledge	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication studies, migration studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	 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.
	Professional Competence (Skills)
	In selected sub-areas students can
C1:80-	 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 successful
36105	 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	
	Personal Competences (Social Skills)
	Students will be able

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

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

Module M0603: N	Ionlinear Structural Analys	sis			
Courses					
Title Nonlinear Structural Analysi Nonlinear Structural Analysi	is (L0277) is (L0279)	Ty Leo Reo	p cture citation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Alexander Düster				
Admission Requirements	None	None			
Recommended Previous Knowledge	Knowledge of partial differential equat	tions is recomme	ended.		
Educational Objectives	After taking part successfully, students	s have reached t	the following learning r	esults	
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 mechanical background.				
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. 				
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.				
Autonomy	Students are able to + acquire independently knowledge to solve complex problems.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory Materials Science: Specialisation Modeling: 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				

ourse L0277: Nonlinear Structural Analysis			
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Alexander Düster		
Language	DE/EN		
Cycle	WiSe		
Content	 Introduction Nonlinear phenomena Mathematical preliminaries Basic equations of continuum mechanics Spatial discretization with finite elements Solution of nonlinear systems of equations Solution of elastoplastic problems Stability problems Contact problems 		
Literature	 Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014. Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008. Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001. 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	
СР	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: T	hermal Engineering				
Courses					
Title	Тур		Hrs/wk	CP	
Thermal Engineering (L0023	B) Lecture		3	5	
Thermal Engineering (L0024	4) Recitation	Section (large)	1	1	
Module Responsible	Prof. Gerhard Schmitz				
Admission Requirements	None				
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfe	ir			
Educational Objectives	After taking part successfully, students have reached the follo	owing learning i	results		
Professional Competence					
Knowledge	Students know the different energy conversion stages and the difference between efficiency and annual efficiency. They have increased knowledge in heat and mass transfer, especially in regard to buildings and mobile applications. They are familiar with German energy saving code and other technical relevant rules. They know to differ different heating systems in the domestic and industrial area and how to control such heating systems. They are able to model a furnace and to calculate the transient temperatures in a furnace. They have the basic knowledge of emission formations in the flames of small burners and how to conduct the flue gases into the atmosphere. They are able to model thermodynamic systems with object oriented languages.				
Skills	Students are able to calculate the heating demand for different heating systems and to choose the suitable components. They are able to calculate a 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.				
Personal Competence					
Social Competence The students are able to discuss in small groups and develop an approach.					
Autonomy	Students are able to define independently tasks, to 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	Credit points 6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	60 min				
Assignment for the Following Curricula	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Compulsory Energy Systems: Specialisation Marine Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Technical Complementary Course: Elective Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory				

Course L0023: Thermal	Engineering			
Тур	Lecture			
Hrs/wk	3			
СР	5			
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42			
Lecturer	Prof. Gerhard Schmitz			
Language	DE			
Cycle	WiSe			
 Introduction Fundamentals of Thermal Engineering 2.1 Heat Conduction 2.2 Convection 2.3 Radiation 2.4 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 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 plant 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	

Courses					
Title Vibration Theory (L0701)		Typ Integrated Lecture	Hrs/wk 4	CP 6	
Module Responsible	Prof. Norbert Hoffmann				
Admission Requirements	None				
Recommended Previous Knowledge	 Calculus Linear Algebra Engineering Mechanics 				
Educational Objectives	After taking part successfully, students	have reached the following learning	ng results		
Professional Competence					
Knowledge	Students are able to denote terms and concepts of Vibration Theory and develop them further.				
Skills	Students are able to denote methods o	f Vibration Theory and develop the	em further.		
Personal Competence					
Social Competence	Students can reach working results also	o in groups.			
Autonomy	Students are able to approach individua	ally research tasks in Vibration The	eory.		
Workload in Hours	Independent Study Time 124, Study Tir	ne in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	2 Hours				
Assignment for the Following Curricula	Energy Systems: Core qualification: Ele Computational Science and Engineering International Management and Enginee Biomedical Engineering: Specialisati Compulsory Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Product Development, Materials and Pr Naval Architecture and Ocean Engineer Theoretical Mechanical Engineering: Co Theoretical Mechanical Engineering: To	ctive Compulsory g: Specialisation Scientific Comput ring: Specialisation II. Mechatronic on Artificial Organs and Rege Implants and Endoprostheses: Ele Medical Technology and Control TI Management and Business Admin oduction: Core qualification: Comp ing: Core qualification: Elective Co re qualification: Elective Compulse chnical Complementary Course: E	ing: Elective Co ss: Elective Cor enerative Mec ctive Compulso heory: Elective istration: Elective ulsory mpulsory ory lective Compul	ompulsory npulsory licine: Elective ory Compulsory ve Compulsory sory	

Course L0701: Vibratio	n Theory
Тур	Integrated 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: F	inite Elements M	lethods			
Courses					
Title Finite Element Methods (L02 Finite Element Methods (L08	291) 304)		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Otto von Estorff				
Admission Requirements	None				
Recommended Previous Knowledge	Mechanics I (Statics, Me Mathematics I, II, III (in	chanics of Materials) ar particular differential ec	nd Mechanics II (Hydrostatics quations)	, Kinematics	s, Dynamics)
Educational Objectives	After taking part succes	sfully, students have re	ached the following learning	results	
Professional Competence	The students possess a are able to give an over	n in-depth knowledge re view of the theoretical	egarding the derivation of th and methodical basis of the i	e finite elem method.	ent method and
Knowledge	-				
Skills	The students are capa assembling the corresp	ble to handle enginee onding system matrices	ring problems by formulating, and solving the resulting sy	ng suitable /stem of equ	finite elements lations.
Personal Competence Social Competence Autonomy	Students can work in sr The students are able finite element routines.	nall groups on specific p to independently solve Problems can be identii	problems to arrive at joint sole challenging computational fied and the results are critic	lutions. problems a ally scrutini;	nd develop own zed.
Workload in Hours	Indonondont Study Tim	o 124. Study Timo in Lo	acturo 56		
Credit points	6	e 124, Study Time in Le			
Course achievement	CompulsorBonus No 20 %	Form Midterm	Description		
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Civil Engineering: Core qualification: Compulsory Energy Systems: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Computational Science and Engineering: Specialisation Scientific Computing: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production Elective Compulsory Mechatronics: Core qualification: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Product Development, Materials and Production: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				

Course L0291: Finite Element Methods		
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	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 El	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: C	control Systems Theory and D	esign		
Courses				
Title Control Systems Theory and Control Systems Theory and	d Design (L0656) d Design (L0657)	Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible	Prof. Herbert Werner			
Admission	None			
Recommended	Introduction to Control Systems			
Previous Knowledge	After taking part successfully, students ba	in reached the following learning	roculto	
Professional Professional	After taking part successfully, students hav	reached the following learning	results	
Competence				
Knowledge	 Students can explain how linear dyr can interpret the system response t space They can explain the system propert state feedback and state estimation, They can explain the significance of They can explain observer-based stat disturbance rejection They can explain the z-transform and They can explain state space models They can explain the experimental id identification problem can be solved They can explain how a state space response 	amic systems are represented a to initial states or external excita ties controllability and observabili respectively a minimal realisation the feedback and how it can be us multi-input multi-output systems d its relationship with the Laplace s and transfer function models of dentification of ARX models of dyn by solving a normal equation the model can be constructed from	s state spa tion as traje ty, and thei sed to achie Transform discrete-tim namic syste om a discre	e models; they ectories in state r relationship to we tracking and e systems ms, and how the ce-time impulse
Skills	 Students can transform transfer fund They can assess controllability and c They can design LQG controllers for They can carry out a controller deside which is appropriate for a giv They can identify transfer function experimental data They can carry out all these tasks us Identification Toolbox, Simulink) 	ction models into state space mod observability and construct minim multivariable plants sign both in continuous-time and ren sampling rate models and state space models sing standard software tools (Matl	dels and vice al realisatio discrete-tir of dynami ab Control 1	e versa ns ne domain, and c systems from oolbox, System
Personal Competence	Students can work in small groups on speci	fic problems to arrive at joint solu	utions.	
Social Competence	Students can obtain information from n	rovided sources (lecture notes	software	documentation
Autonomy	They can assess their knowledge in weekly	on-line tests and thereby control	their learni	ng progress.
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination Examination duration				
Assignment for the Following Curricula	Computer Science: Specialisation Intelligen Electrical Engineering: Core qualification: C Energy Systems: Core qualification: Electiv Aircraft Systems Engineering: Specialisatio Computational Science and Engineering: Computational Science and Engineering: S Elective Compulsory International Management and Engineer Compulsory International Management and Engineering Mechanical Engineering: Specialisation Compulsory International Management and Engineering Mechanical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Mar Product Development, Materials and Produc Theoretical Mechanical Engineering: Core of	ce Engineering: Elective Compuls ompulsory e Compulsory n Aircraft Systems: Compulsory n Avionic and Embedded Systems Specialisation Systems Engineer pecialisation Kernfächer Ingenieu ering: Specialisation II. Electri g: Specialisation II. Mechatronics: Specialisation Mechatronics: Elect ry Artificial Organs and Regene lants and Endoprostheses: Electiv ical Technology and Control Theo agement and Business Administr ction: Core qualification: Elective jualification: Compulsory	erry Elective C ring and Ro rswissensch cal Engine Elective Cor tive Compulsor rative Mec ve Compulsory ation: Electi Compulsory	ompulsory botics: Elective aften (2 Kurse): ering: Elective npulsory sory iicine: Elective ory ve Compulsory

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

Course L0657: Control Systems 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: C	Continuum Mechanics			
Courses				
Title		Тур	Hrs/wk	CP
Continuum Mechanics (L15)	cise (L1534)	Recitation Section (small)	2	3
Module Responsible	Prof Christian Cyron			
Admission				
Requirements	None			
Recommended Previous Knowledge	Basics of linear continuum mechanics as taugh stress, linear strain, free-body principle, linear-	nt, e.g., in the module Mechar elastic constitutive laws, strai	nics II (forces n energy).	s and moments,
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	The students can explain the fundamental con	cepts to calculate the mechar	iical behavio	or of materials.
Skills	The students can set up balance laws and app in applied contexts as in research contexts.	oly basics of deformation theo	ory to specif	ic aspects, both
Personal Competence				
Social Competence	The students are able to develop solutions, develop ideas further.	to present them to speciali	sts in writte	en form and to
Autonomy	The students are able to assess their own stre their own identify and solve problems in the a required to this end.	engths and weaknesses. They irea of continuum mechanics	r can indepe and acquire	endently and on the knowledge
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	45 min			
Assignment for the Following Curricula	Computational Science and Engineering: Speci Materials Science: Specialisation Modeling: Ele Mechanical Engineering and Management: Spe Mechatronics: Technical Complementary Cours Biomedical Engineering: Specialisation Art Compulsory Biomedical Engineering: Specialisation Implant Biomedical Engineering: Specialisation Medical Biomedical Engineering: Specialisation Medical Biomedical Engineering: Specialisation Manage Product Development, Materials and Productio Theoretical Mechanical Engineering: Core qual Theoretical Mechanical Engineering: Core qual	alisation Scientific Computing ctive Compulsory ecialisation Materials: Elective se: Elective Compulsory ificial Organs and Regene and Endoprostheses: Elective Technology and Control Theo ement and Business Administr n: Core qualification: Elective Complementary Course: Elect ification: Elective Compulsory ification: Elective Compulsory	: Elective Co Compulsory rative Mec ve Compulso vry: Elective ation: Electi Compulsory tive Compul	mpulsory licine: Elective ory Compulsory ve Compulsory sory

Course L1533: Continu	um Mechanics
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
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: Continue	um Mechanics Exercise
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
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: M	laterial Modeling			
	-			
Courses				
Title Material Modeling (L1535)		Typ	Hrs/wk	CP 3
Material Modeling (L1536)		Recitation Section (small)	2	3
Module Responsible	Prof. Christian Cyron			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of linear and nonlinear continuu Continuum Mechanics (forces and mor linear and nonlinear constitutive laws, s	m mechanics as taught, e.g., in the ments, stress, linear and nonlinear train energy)	e modules Me strain, free-l	echanics II and body principle,
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	The students can explain the fundamen	tals of multidimensional consitutive r	material laws	
Skills	The students can implement their own material laws in finite element codes. In particular, the students can apply their knowledge to various problems of material science and evaluate the corresponding material models.			
Personal Competence				
Social Competence	The students are able to develop solution	ons, to present them to specialists an	d to develop	ideas further.
Autonomy	The students are able to assess their o their own identify and solve problems required to this end.	wn strengths and weaknesses. They in the area of materials modeling a	r can indeper and acquire f	ndently and on the knowledge
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	45 min			
Assignment for the Following Curricula	Computational Science and Engineering Materials Science: Specialisation Modeli Mechanical Engineering and Manageme Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation I Biomedical Engineering: Specialisation I Biomedical Engineering: Specialisation I Product Development, Materials and Pro	: Specialisation Scientific Computing ng: Elective Compulsory nt: Specialisation Materials: Elective on Artificial Organs and Regene mplants and Endoprostheses: Electiv Medical Technology and Control Theo Management and Business Administr duction: Core qualification: Elective	: Elective Cor Compulsory rative Medi- ve Compulsor ory: Elective C ation: Electiv Compulsory	npulsory cine: Elective y Compulsory e 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. Christian Cyron
Language	DE
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	l Modeling
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
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: A	pplied Statistic	s			
Courses					
Title			Тур	Hrs/wk	СР
Applied Statistics (L1584)			Lecture	2	3
Applied Statistics (L1586)			Project-/problem-based Learning	2	2
Applied Statistics (L1585)			Recitation Section (small)	1	1
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge of sta	atistical methods			
Educational Objectives	After taking part succe	essfully, students have rea	ched the following learning	results	
Professional Competence					
Knowledge	Students can explain t	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				
Course achievement	CompulsorBonus Yes None	Form Written elaboration	Description		
Examination	Written exam				
Examination duration and scale	90 minutes, 28 questi	ons			
Assignment for the Following Curricula	Mechanical Engineerir Mechatronics: Special Mechatronics: Special Biomedical Engineerin Product Development, Theoretical Mechanica Theoretical Mechanica	ng and Management: Speci isation System Design: Ele isation Intelligent Systems og: Core qualification: Com Materials and Production: al Engineering: Technical C al Engineering: Specialisati	alisation Management: Elec ctive Compulsory and Robotics: Elective Com pulsory Core qualification: Elective omplementary Course: Elec on Bio- and Medical Technol	tive Compul pulsory Compulsory tive Compul logy: Electiv	lsory , sory e Compulsory

Course L1584: Applied	Statistics
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
Content	 The goal is to introduce students to the basic statistical methods and their application to simple problems. The topics include: Chi square test Simple regression and correlation Multiple regression and correlation One way analysis of variance Two way analysis of variance Discriminant analysis Analysis of categorial data Chossing the appropriate statistical method Determining critical sample sizes
Literature	Applied Regression Analysis and Multivariable Methods, 3rd Edition, David G. Kleinbaum Emory University, Lawrence L. Kupper University of North Carolina at Chapel Hill, Keith E. Muller University of North Carolina at Chapel Hill, Azhar Nizam Emory University, Published by Duxbury Press, CB © 1998, ISBN/ISSN: 0-534-20910-6

Course L1586: Applied	Statistics
Тур	Project-/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).
Literature	Student Solutions Manual for Kleinbaum/Kupper/Muller/Nizam's Applied Regression Analysis and Multivariable Methods, 3rd Edition, David G. Kleinbaum Emory University Lawrence L. Kupper University of North Carolina at Chapel Hill, Keith E. Muller University of North Carolina at Chapel Hill, Azhar Nizam Emory University, Published by Duxbury Press, Paperbound © 1998, ISBN/ISSN: 0-534-20913-0

Module M1204: M	lodelling and Optimizatio	on in Dynamics			
Courses					
Title		Тур	Hrs/wk	СР	
Flexible Multibody Systems Optimization of dynamical s	(L1632) systems (L1633)	Lecture Lecture	2 2	3 3	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous Knowledge	 Mathematics I, II, III Mechanics I, II, III, IV Simulation of dynamical System 	ems			
Educational Objectives	After taking part successfully, studer	nts have reached the following lea	rning results		
Professional					
Knowledge	Students demonstrate basic knowledge and understanding of modeling, simulation and analysis of complex rigid and flexible multibody systems and methods for optimizing dynamic systems after successful completion of the module.				
	Students are able				
	+ to think holistically				
Skills	+ to independently, securly and critically analyze and optimize basic problems of the dynamics of rigid and flexible multibody systems				
	+ to describe dynamics problems mathematically				
	+ to optimize dynamics problems				
Personal Competence					
	Students are able to				
Social Competence	+ solve problems in heterogeneous groups and to document the corresponding results.				
	Students are able to				
	+ assess their knowledge by means	of exercises.			
Autonomy	+ acquaint themselves with the necessary knowledge to solve research oriented tasks.				
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and scale	30 min				
Assignment for the Following Curricula	Energy Systems: Core qualification: Aircraft Systems Engineering: Specia Mechatronics: Specialisation System Mechatronics: Specialisation Intellige Product Development, Materials and Theoretical Mechanical Engineering: Theoretical Mechanical Engineering:	Elective Compulsory alisation Aircraft Systems: Elective Design: Elective Compulsory ent Systems and Robotics: Elective Production: Core qualification: Ele Core qualification: Elective Compu Technical Complementary Course	Compulsory compulsory ctive Compulsory ulsory : Elective Compul	, sory	

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	 Basics of Multibody Systems Basics of Continuum Mechanics Linear finite element modelles and modell reduction Nonlinear finite element Modelles: absolute nodal coordinate formulation Kinematics of an elastic body Kinetics of an elastic body 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: Optimiza	ation of dynamical systems
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried, Dr. Leo Dostal
Language	DE
Cycle	WiSe
Content	 Formulation and classification of optimization problems Scalar Optimization Sensitivity Analysis Unconstrained Parameter Optimization Constrained Parameter Optimization Stochastic optimization Multicriteria Optimization 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: H	ligh-Order FEM				
Courses					
Title High-Order FEM (L0280) High-Order FEM (L0281)			Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Alexander Düster				
Admission Requirements	None				
Recommended Previous Knowledge	Knowledge of partial di	fferential equations is reco	mmended.		
Educational Objectives	After taking part succe	ssfully, students have reac	hed the following learning	results	
Professional Competence					
Knowledge	 Students are able to + give an overview of the different (h, p, hp) finite element procedures. + explain high-order finite element procedures. + specify problems of finite element procedures, to identify them in a given situation and to explain their mathematical and mechanical background. 				
Skills	 Students are able to + apply high-order finite elements to problems of structural mechanics. + select for a given problem of structural mechanics a suitable finite element procedure. + critically judge results of high-order finite elements. + transfer their knowledge of high-order finite elements to new problems. 				
Personal Competence					
Social Competence	Students are able to + solve problems in heterogeneous groups and to document the corresponding results.				
Autonomy	Students are able to + assess their knowledge by means of exercises and E-Learning. + acquaint themselves with the necessary knowledge to solve research oriented tasks.				
Workload in Hours	Independent Study Tim	ne 124, Study Time in Lectu	ıre 56		
Credit points	6				
Course achievement	CompulsorBonus Form Description No 10 % Presentation Forschendes Lernen				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Energy Systems: Core International Managen Elective Compulsory Materials Science: Spee Mechanical Engineerir Elective Compulsory Mechatronics: Technica Product Development, Naval Architecture and Theoretical Mechanical Theoretical Mechanical	qualification: Elective Comp nent and Engineering: Spe cialisation Modeling: Elective ag and Management: Sp al Complementary Course: Materials and Production: C Ocean Engineering: Core of Engineering: Technical Co Engineering: Core qualificat	oulsory ecialisation II. Product Dev ecialisation Product Dev Elective Compulsory Core qualification: Elective qualification: Elective Comp mplementary Course: Eleci ation: Elective Compulsory	velopment a elopment a Compulsory sulsory tive Compuls	and Production: nd Production: sory

Course L0280: High-Or	der FEM
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	EN
Cycle	SoSe
Content	 Introduction 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 Computation and hp-adaptivity High-order fictitious domain methods
Literature	 [1] Alexander Düster, High-Order FEM, Lecture Notes, Technische Universität Hamburg-Harburg, 164 pages, 2014 [2] Barna Szabo, Ivo Babuska, Introduction to Finite Element Analysis – Formulation, Verification and Validation, John Wiley & Sons, 2011

Course L0281: High-Order FEM		
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: Acoustics)	Technical Acoustics I (Acoustic	Waves, Noise F	Protection, Psycho
Courses			
Title Technical Acoustics I (Acous Technical Acoustics I (Acous	tic Waves, Noise Protection, Psycho Acoustics) (L0516) tic Waves, Noise Protection, Psycho Acoustics) (L0518)	Typ Lecture Recitation Section (large)	Hrs/wk CP 2 3 2 3
Module Responsible	Prof. Otto von Estorff		
Admission Requirements	None		
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and M Mathematics I, II, III (in particular differential equat	lechanics II (Hydrostatics ions)	;, Kinematics, Dynamics)
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results
Professional Competence			
Knowledge	The students possess an in-depth knowledge in acoustics regarding acoustic waves, noise protection, and psycho acoustics 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 methodologies and measurement procedures treated within the module.		
Personal Competence			
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.		
Autonomy	The students are able to independently solve challenging acoustical problems in the areas treated within the module. Possible conflicting issues and limitations can be identified and the results are critically scrutinized.		
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56	
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Comp Aircraft Systems Engineering: Specialisation Cabin International Management and Engineering: Specia Mechatronics: Specialisation System Design: Electi Product Development, Materials and Production: Cr Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Con Theoretical Mechanical Engineering: Specialisati Compulsory	ulsory Systems: Elective Comp alisation II. Aviation Syste ve Compulsory ore qualification: Elective Science: Elective Comp nplementary Course: Elec on Product Developmer	ulsory ems: Elective Compulsory e Compulsory ulsory ctive Compulsory nt and Production: Elective

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

Course L0518: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics) Typ Recitation Section (large) Hrs/wk 2 CP OP 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: B	oundary Eleme	nt Methods				
Courses						
Title			Тур	Hrs/wk	СР	
Boundary Element Methods	(L0523)		Lecture	2	3	
Boundary Element Methods	(L0524)		Recitation Section (large)	2	3	
Module Responsible	Prof. Otto von Estorff					
Admission Requirements	None					
Recommended Previous Knowledge	Mechanics I (Statics, M Mathematics I, II, III (ir	lechanics of Mater particular differe	ials) and Mechanics II (Hydrostatics ntial equations)	, Kinematic	s, Dynamics)	
Educational Objectives	After taking part succe	essfully, students h	ave reached the following learning	results		
Professional						
Competence	The students possess	an in-denth knowl	edge regarding the derivation of the	e boundary	element method	
	and are able to give a	n overview of the t	heoretical and methodical basis of	the method		
Knowledge	5					
	The students are capa	able to handle eng	ineering problems by formulating s	suitable bou	indary elements,	
CL/11-	assembling the corres	ponding system in	actives, and solving the resulting sy	stem of equ		
Skills						
Personal Competence						
Social Competence	Students can work in s	small groups on sp	ecific problems to arrive at joint sol	utions.		
Social competence	The students are able	ta indonondontly	colve challenging computational	problems a	nd dovelon own	
	boundary element rou	tines. Problems ca	n be identified and the results are o	critically scr	utinized.	
Autonomy						
Workload in Hours	Independent Study Tir	ne 124, Study Tim	e in Lecture 56			
Credit points	6					
Course achievement	CompulsorBonus No 20 %	Form Midterm	Description			
Examination	Written exam					
Examination duration	90 min					
and scale	50 11111					
	Civil Engineering: Spec	cialisation Structur	al Engineering: Elective Compulsor inical Engineering: Elective Compute	y sorv		
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy Systems: Core qualification: Elective Compulsory Computational Science and Engineering: Specialisation Scientific Computing: Elective Compulsor						
						Assignment for the
Following Curricula	Elective Compulsory	sation System Dec	ian: Elective Compulsory			
	Product Development,	Materials and Pro	duction: Core qualification: Elective	Compulsor	y	
	Technomathematics: S	Specialisation III. E	ngineering Science: Elective Compu	ilsory		
	Theoretical Mechanica	I Engineering: Tec	hnical Complementary Course: Elec	tive Compu	lsory	

Course L0523: Bounda	ry Element Methods
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	 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		
СР	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		

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Courses				
Title Practical Course Product Deve	elopment, Materials and Production (L1566)	Typ Practical Course	Hrs/wk 6	CP 6
Module Responsible	rof. Wolfgang Hintze			
Admission	lone			
Requirements	Product Development:			
P Recommended Previous Knowledge P	 Product Development: Lectures: Mechanics I-III Lectures: Integrated Product Develo Materials: Lectures: Structural Metallic Materials Materials Testing Lectures: Structure and Propertie Manufacturing of Polymers and Comproduction: Lecture: Production Engineering Lectures: Forming and Cutting Tech Lectures: Machine Tools and Robotion 	opment I incl. CAD practical tra als, Metallic Materials for Airco as of Polymers, Structure a posites nology, Methods of production c	aining raft Applications, and Properties o n process design	Introduction to
Educational Objectives A	fter taking part successfully, students ha	ve reached the following learr	ning results	
Professional Competence				
S	tudents can			
Knowledge	 represent more complex context of different fields of study. describe functionality of modern measurement instrumentations and machine technologies. 			
S Skills	 Students are capable of applying theoretical knowledge for practical applications. applying provided experimental methods for examining contexts of different fields of study. analyzing and evaluating experimental results by using provided methods. applying modern measurement instrumentations. 			
Porconal Compotonco				
	tudents can			
Social Competence	 carry out and document experiment present and discuss experimental re 	tal work in groups. esults in mixed teams of differ	rent fields of stud	у.
S	 tudents are able to carry out parts of experimental wor choose and apply suitable instrume assess own strengths and weakness 	k independently guided by tea nts. ses.	achers.	
Workload in Hours	ndependent Study Time 96, Study Time ir	n Lecture 84		
Credit points 6	· · · · · · · · · · · · · · · · · · ·			
Course achievement N	None			
Examination V	Vritten elaboration			
Examination duration and scale				
Assignment for the B Following Curricula P	iomedical Engineering: Core qualification roduct Development, Materials and Produ	: Compulsory uction: Core qualification: Com	npulsory	

Course L1566: Practical Course Product Development, Materials and Production				
Тур	Practical Course			
Hrs/wk	6			
CP	6			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Lecturer	f. Wolfgang Hintze, Prof. Josef Schlattmann, Prof. Dieter Krause, Prof. Claus Emmelmann, Prof. Uwe Itin, Prof. Bodo Fiedler, Prof. Hermann Lödding, Prof. Michael Morlock, Prof. Gerold Schneider, Prof. orsten 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: N	onlinear Dynamics				
Courses					
Title Nonlinear Dynamics (L0702)		Typ Integrated Lecture	Hrs/wk 4	CP 6
Module Responsible	Prof. Norbert Hoffmann				
Admission Requirements	None				
Recommended Previous Knowledge	CalculusLinear AlgebraEngineering Mechanics				
Educational Objectives	After taking part successfully,	students have reac	hed the following learn	ing results	
Professional Competence					
Knowledge	Students are able to reflect existing terms and concepts in Nonlinear Dynamics and to develop and research new terms and concepts.				
Skills	Students are able to apply e novel methods and procedure	xisting methods an s.	nd procesures of Nonlir	near Dynamics	and to develop
Personal Competence					
Social Competence	Students can reach working re	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 Lectu	ure 56		
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	2 Hours				
Assignment for the Following Curricula	Aircraft Systems Engineering: Computational Science and Er International Management and Mechanical Engineering and M Mechatronics: Specialisation S Mechatronics: Specialisation II Biomedical Engineering: Speci Biomedical Engineering: Speci Biomedical Engineering: Speci Biomedical Engineering: Speci Biomedical Engineering: Speci Biomedical Engineering: Speci Biomedical Mechanical Engine Theoretical Mechanical Engine	Specialisation Aircr rgineering: Specialis d Engineering: Specialis d Engineering: Specialis d Engineering: Specialis isotom Design: Elec telligent Systems a specialisation Medical Te ialisation Medical Te ialisation Managem als and Production: C pering: Core qualific	aft Systems: Elective Cr sation Scientific Compu- ialisation II. Mechatronics: I tive Compulsory and Robotics: Elective Cr ial Organs and Reg and Endoprostheses: Ele echnology and Control T ent and Business Admir Core qualification: Elect implementary Course: E ation: Elective Compuls	ompulsory ting: Elective Cor cs: Elective Compu compulsory enerative Med ective Compulsor Theory: Elective Distration: Elect vie Compulsory Elective Compul ory	ompulsory npulsory lsory dicine: Elective ory Compulsory ve Compulsory sory

Course L0702: Nonline	ar Dynamics
Тур	Integrated 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 M1339: analysis	Design optimization and probab	ilistic approact	nes in	structural
Courses				
Title Design Optimization and Pro Design Optimization and Pro	T obabilistic Approaches in Structural Analysis (L1873) L obabilistic Approaches in Structural Analysis (L1874) R	yp ecture ecitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous Knowledge	Technical mechanics Higher math			
Educational Objectives	After taking part successfully, students have reached	the following learning r	esults	
Professional Competence				
Knowledge	 Design optimization Gradient based methods Genetic algorithms Optimization with constraints Topology optimization Reliability analysis Stochastic basics Monte Carlo methods Semi-analytic approaches robust design optimization Robustness measures Coupling of design optimization and reli 	ability analysis		
Skills	 Application of optimization algorithms and probabilistic methods in the design of structures Programming with Matlab Implementation of algorithms Debugging 			
Personal Competence				
Social Competence	 Team work Oral explanation of the the work 			
Autonomy	 Application of methods learned in the framework Familiarizing with source code provided Description of approaches and results 	ork of a home work		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	10 pages			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Air Trans Product Development, Materials and Production: Core Theoretical Mechanical Engineering: Technical Compl Theoretical Mechanical Engineering: Core qualificatio	sportation Systems: Elect e qualification: Elective (lementary Course: Elect n: Elective Compulsory	tive Compu Compulsory ive Compuls	lsory ory

Course L1873: Design Optimization and Probabilistic Approaches in Structural Analysis				
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Benedikt Kriegesmann			
Language	DE			
Cycle	SoSe			
Content	In the course the theoretic basics for design optimization and reliability analysis are taught, where the focus is on the application of such methods. The lectures will consist of presentations as well as computer exercises. In the computer exercises, the methods learned will be implemented in Matlab for understanding the practical realization. The following contents will be considered: Design optimization Gradient based methods Genetic algorithms Optimization with constraints Topology optimization Reliability analysis Stochastic basics Monte Carlo methods Semi-analytic approaches robust design optimization Robustness measures Coupling of design optimization and reliability analysis 			
Literature	 Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000. 			

Course L1874: Design (Optimization and Probabilistic Approaches in Structural Analysis
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	Matlab exercises complementing the lecture
Literature	siehe Vorlesung

Module M0806: T	echnical Acoustics II (Room Aco	oustics, Computation	al Meth	ods)
Courses				
Title Technical Acoustics II (Roon Technical Acoustics II (Roon	n Acoustics, Computational Methods) (L0519) n Acoustics, Computational Methods) (L0521)	Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous Knowledge	Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics) Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have	eached 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	Students can work in small groups on specific problems to arrive at joint solutions.			
Autonomy	The students are able to independently solve challenging acoustical problems in the areas treated within the module. Possible conflicting issues and limitations can be identified and the results are critically scrutinized.			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation C Mechatronics: Specialisation System Design: 1 Product Development, Materials and Producti Theoretical Mechanical Engineering: Technica Theoretical Mechanical Engineering: Specia Compulsory	Cabin Systems: Elective Compu Elective Compulsory on: Core qualification: Elective I Complementary Course: Elect lisation Product Development	lsory Compulsory tive Compuls t and Produ	sory uction: Elective

Course L0519: Technical Acoustics II (Room Acoustics, Computational Methods)	
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	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 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: Technica	al Acoustics II (Room Acoustics, Computational Methods)
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Тур	Recitation Section (large)
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	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1140: 7 to Subject Specif	Technical Complementary Course Core Studies for ic Regulations)	or PEPMS	(according
Courses			
Title	Тур	Hrs/wk	СР
Module Responsible	Prof. Dieter Krause		
Admission Requirements	None		
Recommended Previous Knowledge	See selected module according to FSPO		
Educational Objectives	After taking part successfully, students have reached the following learni	ng 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		
Course achievement	None		
Examination	according to Subject Specific Regulations		
Examination duration and scale	See selected module according to FSPO		
Assignment for the Following Curricula	Product Development, Materials and Production: Core qualification: Elect	ive Compulsory	/

Module M1184: R	esearch Project Product Development, Materials and Production
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Dozenten des Studiengangs
Admission Requirements	None
Recommended Previous Knowledge	Subjects of the Master program and the chosen specialisation.
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 their 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
Course achievement	None
Examination	Study work
Examination duration and scale	according to FSPO
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: A	lircraft Systems I			
Courses				
Title Aircraft Systems I (L0735) Aircraft Systems I (L0739)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
	Basic knowledge in:			
Recommended Previous Knowledge	 Mathematics Mechanics Thermodynamics Electrical Engineering Hydraulics Control Systems 			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence	Chudanta ana akia ta			
Knowledge	 Describe essential components and design Give an overview of the functionality of air Explain the need for high-lift systems such Assess the challenge during the design of s 	points of hydraulic, electri conditioning systems as ist functionality and effe supply systems of an aircra	cal and high- ects ft	lift systems
Skills	 Students are able to: Design hydraulic and electric supply system Design high-lift systems of aircrafts Analyze the thermodynamic behaviour of a 	ns of aircrafts ir conditioning systems		
Personal Competence				
	Students are able to:			
Social Competence	 Perform system design in groups and prese 	ent and discuss results		
	Students are able to:			
Autonomy	Reflect the contents of lectures autonomou	isly		
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points				
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: E Aircraft Systems Engineering: Core qualification: C International Management and Engineering: Speci Product Development, Materials and Producti Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Technical Co Theoretical Mechanical Engineering: Specialisation	Elective Compulsory Compulsory ialisation II. Aviation System ion: Specialisation Produ Specialisation Production: Ele Specialisation Materials: Elec mplementary Course: Elec n Aircraft Systems Enginee	ms: Elective (ict Developr Elective Comp ective Compuls tive Compuls tring: Elective	Compulsory ment: Elective pulsory Jlsory sory e Compulsory

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 hydrauli systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and hea balances; emergency power) Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrica power distribution; bus systems; monitoring; load analysis) High Lift Systems (Principles; investigation of loads and system actuation power; principles an 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)
Literature	 Moir, Seabridge: Aircraft Systems Green: Aircraft Hydraulic Systems Torenbek: Synthesis of Subsonic Airplane Design SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

Course 0730: Aircraft	Sustans I
Tvn	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: M	lethods of Integrated Pi	roduct Develo	opment		
Courses					
Title Integrated Product Develop Integrated Product Develop	ment II (L1254) ment II (L1255)	Ty Le Pro	/P cture pject-/problem-based arning	Hrs/wk 3 2	CP 3
Module Responsible	Prof Dieter Krause		g		
Admission	None				
Recommended Previous Knowledge	Basic knowledge of Integrated proc	duct development a	and applying CAE syst	ems	
Educational Objectives	After taking part successfully, stud	lents have reached	the following learning	results	
Professional Competence	After passing the module students	are able to:			
Knowledge	 explain technical terms of de describe essential elements describe current problems a 	esign methodology, of construction ma and the current state	, nagement, e of research of integ	rated product	development.
Skills	 After passing the module students select and apply proper consistent as adapt new boundary cond solve product development choose and execute appropri 	are able to: struction methods f ditions, problems with the a riate moderation te	for non-standardized : assistance of a worksl chniques.	solutions of p nop based ap	roblems as well proach,
Personal Competence					
Social Competence	After passing the module students prepare and lead team meet work in teams on complex ta represent problems and solution 	are able to: tings and moderation asks, utions and advance	on processes, ideas.		
Autonomy	After passing the module students give a structured feedback a implement the accepted fee 	are able to: and accept a critica edback autonomous	l feedback,		
Workload in Hours	Independent Study Time 110, Stud	ly Time in Lecture 7	70		
Credit points	b None				
Examination	Oral exam				
Examination duration and scale	30 Minuten				
Assignment for the Following Curricula	Aircraft Systems Engineering: Spec Aircraft Systems Engineering: Spec International Management and Er Elective Compulsory Mechatronics: Specialisation Syster Product Development, Materials ar Product Development, Materials ar Product Development, Materials ar Theoretical Mechanical Engineering Theoretical Mechanical Engineering Compulsory	cialisation Cabin Sys cialisation Air Trans ngineering: Special m Design: Elective nd Production: Spec nd Production: Spec nd Production: Spec g: Technical Comple ng: Specialisation	stems: Elective Comp portation Systems: El isation II. Product De Compulsory ialisation Product Dev ialisation Production: ialisation Materials: E ementary Course: Ele Product Developmen	ulsory ective Compu- evelopment a relopment: Co Elective Compu- lective Compu- ctive Compu- nt and Produ	ilsory and Production: pmpulsory pulsory ulsory sory uction: Elective

Course L1254: Integrat	ed Product 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
	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
Content	 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. 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: Integrat	ed Product Development II
Тур	Project-/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: F	luidics			
Courses				
Title		Тур	Hrs/wk	СР
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Project-/problem-based	1	2
Fluidics (L1257)		Recitation Section (large)	1	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge of mechanics (stereo statics, elas mechanics, and engineering design	stostatics, hydrostatics, kir	nematics an	d kinetics), fluid
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
	After passing the module students are able to			
Knowledge	 explain structures and functionalities of hyc explain the interaction of hydraulic compon explain open and closed loop control of hyd describe functioning and applications of hyc well as centrifugal pumps and aggregates in 	lrostatic, pneumatic, and h ents in hydraulic systems, raulic systems, drodynamic torque convert n plant technology	nydrodynam cers, brakes	iic components, and clutches as
	After passing the module students are able to			
Skills	 analyse and assess hydraulic and pneumati design and dimension hydraulic systems for perform numerical simulations of hydraulic select and adapt pump characteristic curve dimension hydrodynamic torque converters 	c components and system r mechanical applications, systems based on abstrac s for hydraulic systems and brakes for mechanica	s, t problem d il aggregate	efinitions, 25.
Personal Competence	After passing the module students are able to			
Social Competence	 discuss and present functional context in gr organise teamwork autonomously. 	roups,		
Autonomy	After passing the module students are able to obtain necessary knowledge for the simulat 	ion.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90			
Assignment for the Following Curricula	International Management and Engineering: Speci International Management and Engineering: Spe Elective Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Specialisati Compulsory Theoretical Mechanical Engineering: Technical Cor	alisation II. Mechatronics: l cialisation II. Product Deve pecialisation Product Deve pecialisation Production: E pecialisation Materials: Ele ion Product Development mplementary Course: Elect	Elective Cor velopment: C lective Com ective Comp and Prod	npulsory and Production: ompulsory pulsory uction: Elective sory

Course L1256: Fluidics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Cycle	WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines • valves • components • hydrostatic transmissions • examples from industry Pneumatics • generation of compressed air • pneumatic motors • generation of compressed air • pneumatic motors • Examples of use Hydrodynamics • physical fundamentals • hydraulic continous-flow machines • hydraulic continous-flow machines • hydradynamic transmissions • interoperation of motor and transmission Exercise Hydrostatics • reading and design of hydraulic diagrams • dimensioning of hydrostatic traction and working drives • performance calculation Hydrodynamics
	 calculation / dimensioning of hydrodynamic torque converters calculation / dimensioning of centrifugal pumps creating and reading of characteristic curves of pumps and systems Field trip field trip to a regional company from the hydraulic industry.
	Exercise Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model • simulation of common components • variation of simulation parameters • using simulations for system dimensioning and optimisation • (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

Typ Project-/problem-based Learning Hrs/wk 1 CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause
Hrs/wk 1 CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause
CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause
Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause
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
СР	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 M1193: Cabin Systems Engineering				
Courses				
Title Computer and communicati Computer and communicati	on technology in cabin electronics and avionics (L1557) on technology in cabin electronics and avionics (L1558)	Typ Lecture Recitation Section (small)	Hrs/wk 2 1	CP 2 1
Model-Based Systems Engir	neering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering			
Educational Objectives	After taking part successfully, students have reach	ed the following learning i	results	
Professional				
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 network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network • model system functions by means of formal languages SysML/UML and generate software code from the models • execute software code on a minicomputer			
Personal Competence				
Social Competence	Students are able to: • elaborate partial results and merge with others to form a complete solution			
Autonomy	Students are able to: • organize and schedule their practical tasks			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircra Aircraft Systems Engineering: Specialisation Air Tra Aircraft Systems Engineering: Specialisation Cabin International Management and Engineering: Specia Product Development, Materials and Productio Compulsory Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp Theoretical Mechanical Engineering: Technical Con Theoretical Mechanical Engineering: Specialisation	ft Systems: Elective Comp ansportation Systems: Elec Systems: Compulsory alisation II. Aviation Syster on: Specialisation Produ pecialisation Production: Ele pecialisation Materials: Elec nplementary Course: Elect Aircraft Systems Enginee	ulsory ctive Compu ns: Elective ct Developi lective Compu- ctive Compuls ring: Elective	lsory Compulsory ment: Elective pulsory Jlsory ory e Compulsory

Course L1557: Compute	er and communication technology in cabin electronics and avionics		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28		
Lecturer	f. 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 (ADCN)		
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: Compute	er and communication technology in cabin electronics and avionics
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	 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-B	ased Systems Engineering (MBSE) with SysML/UML
Тур	Project-/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? • 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: E	lectricity Generation from	Wind and Hydro Powe	er	
Courses				
Title Renewable Energy Projects in Emerged Markets (L0014) Hydro Power Use (L0013) Wind Turbine Plants (L0011) Wind Foregrup Use, Energy Offebore (L0012)		Typ Project Seminar Lecture Lecture Lecture	Hrs/wk 1 1 2 1	CP 1 1 3 1
Module Responsible	Dr. loachim Gerth			
Admission Requirements	None			
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Technical Thermodynamics II, Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students	have reached the following lear	ning results	
Professional Competence				
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration o 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 seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what the have learned in practice.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
Social Competence		bjet-specificity and multidiscipin	ary within a sen	
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material t 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			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: 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 Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory			

Course L0014: Renewable Energy 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	Prof. Andreas Wiese	
Language	DE	
Cycle	SoSe	
Content	 Introduction Development of renewable energies worldwide 	

Literature Folien der Vorlesung

Course L0013: Hydro P	ower Use
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. 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 hydropectric 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		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann		
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 En	ergy Use - Focus 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 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

Module M0630: R	obotics and Nav	vigation in Me	dicine		
Courses					
Title Robotics and Navigation in Robotics and Navigation in Robotics and Navigation in	Medicine (L0335) Medicine (L0338) Medicine (L0336)		Typ Lecture Project Seminar Recitation Section (Hrs/w 2 2 (small) 1	k CP 3 2 1
Module Responsible	Prof. Alexander Schlaef	fer			
Admission Requirements	None				
Recommended Previous Knowledge	 principles of mat principles of pro- solid R or Matlab 	th (algebra, analysis gramming, e.g., in J o skills	/calculus) ava or C++		
Educational Objectives	After taking part succe	ssfully, students hav	ve reached the following le	arning results	
Professional Competence					
Knowledge	The students can expl and their components safety and regulations.	ain kinematics and in detail. Systems Students can asses	tracking systems in clinic can be evaluated with r s typical systems regardin	al contexts and espect to collis g design and li	d illustrate systems sion detection and imitations.
Skills	The students are able to design and evaluate navigation systems and robotic systems for medical applications.				
Personal Competence Social Competence Autonomy	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work. The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.				
Workload in Hours	Independent Study Tim	ne 110, Study Time	n Lecture 70		
Credit points	6				
Course achievement	CompulsorBonusYes10 %Yes10 %	Form Written elaboration Presentation	Description		
Examination	Written exam				
Examination duration and scale	90 minutes				
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory 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 Specialisation Medical: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology Elective Compulsory				

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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
h	

Module M0996: S	upply Chain Ma	anagement				
Courses						
Title			Т	ур	Hrs/wk	СР
Supply Chain Management	(L1218)		P	roject-/problem-based earning	3	4
Value-Adding Networks (L11	190)		L	ecture	2	2
Module Responsible	Prof. Thorsten Blecker	r				
Admission Requirements	None					
Recommended						
Previous Knowledge						
Educational Objectives Professional	After taking part succ	essfully, students	have reached	the following learning) results	
Competence						
Knowledge	internationalization and • Theoretical Approact • to identify fields of of • reasons for the for (transaction cost theorem • selected approache • to illustrate phases • to understand the relationships. • to explain and catege • to categorize sourci- • advantages and dis the two terms . • to state criteria/ far- (total network costs). • to seplain methods • to interpret phenoty • recognize relationshi models. • to categorise speci- practical examples of	nd globalization and thes and methods decision in SCM. ormation of network ory, principal-agen s to explain the di- of network formative functional meters gorize relationship ng concepts and e advantages of offs ctors/ parameters for location findin upps of production nips between R & ems with the coi of appropriate ap al waste logistics good networking.	nd emerging in in logistics are vorks based on theory, prop levelopment of tion. echanisms of os within networks ishoring and o that influence ishoring and o that influence and produce infiguration of oproaches. is including th	markets illustrated by ad supply chain manage on various theories f perty-right theory) and f networks. i inter-organizational orks. es/ barriers or advanta utsourcing and to illusive re production location action and their location f logistics networks (of eir duties & objective	examples fro lement and u rom instituti the resource and interna ges and disac trate the dist decisions at uns and to de distribution a s and to sta	m practice. se in practice. onal economic -based view. tional networ dvantages. inction betwee the global leve escribe coherer ind spare part te and describ
Skills	 to assess trends and their consequences for to evaluate, anaylse to anaylse partners to select sourcing or advantages and disacd to evaluate location to recognize relation the suitability of spection to anaylse concepts to design subcontration to adopt methods of 	challenges in hat or companies. and systematise and their suitabili procepts for specifi- lvantages of each decisions for pro- nships between F ific models for diff /zed concepts to i uate the product of of Information and cting, procuremer fficient and flow-of f complexity mana	e networks and ity for co-oper ic products / p approach. duction and R R & D and pro ferent situation international p development development ad communica nt, production oriented enter agement and	A network relations bas ation in collaborations product components bas & D based on concept aduction as well as the ns. practices. processes. tion management in l and disposal as well a prise networks. risk management in lo	ed on the lec and coopera ased on the le s. eir locations ogistics. s R & D netw gistics.	ture. tive relations. ecture as well a and to evaluat orks to shape,
Personal Competence						
Social Competence	 to evaluate intercult advance planning a in the lecture. definition of procum networks. design of the procu and core competencie to make decision of and buying/selling ma D. Decision on R & D I the selection of an ap 	tural and internati and design of net ement strategies frement network (es, as well as on the f location for proc arkets, which were ocations based or propriate model.	ional relations work formatic for individual (external/inter he findings of duction taking e also discusso n the insights	ships based on discussion and their objectives parts using the gained rnal/modules etc.) bas the case studies. I into account global c ed in the case studies gained from case studies	ed case studi based on co d knowledge ed on the so ontexts, eval and their dep dies / practica	es. ntent discusse of procuremer urcing concept uation method endence on R al examples an
Autonomy	After completing the Chain Management a	module students nd transfer the ac	s are capable quired knowle	to work independent edge to new problems.	ly on the su	bject of Suppl
Workload in Hours	Independent Study Ti	me 110, Study Tir	me in Lecture	70		
Credit points	6			Description		
Course achievement	No 15 %	Form Subject theo practical work	oretical and	im Rahmen der Lehrv Management"	veranstaltung	"Supply Chair
Examination	Written exam			J		
Examination duration	120 min					
and scale	120 mm					
Assignment for the Following Curricula	International Manag Compulsory Logistics, Infrastructu Product Developmer Compulsory Product Development	ement and Eng re and Mobility: S nt, Materials and r, Materials and Pr	gineering: Sp pecialisation f d Production roduction: Spe	ecialisation I. Electi Production and Logistic : Specialisation Prod cialisation Production:	ves Manage s: Elective Co uct Develop Elective Com	ment: Electiv ompulsory ment: Electiv npulsory

Product Development, Materials and Production: Specialisation Materials: Elective Compulsory

Тур Р	Project-/problem-based Learning
Hrs/wk 3	3
CP 4	1
Workload in Hours In	ndependent Study Time 78, Study Time in Lecture 42
Lecturer P	Prof. Wolfgang Kersten
Language D	DE
Cycle 5	50Se
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 a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods
H F N Literature S C S 1 S C S C S C	 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, vo. pp., S. 105-116. Kuhn, A. und Hellingrath, B. (2002): Supply Chain Management: optimierte Zusammenarbeit in der Nertschöpfungskette, 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 L0.0, [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 Networks		
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	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 M0764: A	ircraft Systems II			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Systems II (L0736)		Lecture	3	4
	Durch French This has been	Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Requirements	None			
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	 describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. explain different configurations and designs and their origins explain atmospheric conditions for icing such as the functionality of anti-ice systems 			
Skills	 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				
	Students are able to:			
Social Competence	Develop joint solutions in mixed teams			
	Students are able to:			
Autonomy	 derive requirements and perform appro systems from complex issues and circumsta 	priate yet simplified de ances in a self-reliant man	sign process ner	ses for aircraft
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory			

Course L0736: Aircraft	Systems II
Тур	Lecture
Hrs/wk	3
СР	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) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
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
СР	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: M	ledical Imaging Systems	
Courses		
Title	Typ Hrs/wk CP	
Medical Imaging Systems (L	.0819) Lecture 4 6	
Module Responsible	Dr. Michael Grass	
Admission Requirements	None	
Recommended Previous Knowledge	none	
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 main clinical imaging systems; Explain how the system components and the overall system of the imaging systems function; Explain and apply the physical processes that make imaging possible and use with the fundamental physical equations; Name and describe the physical effects required to generate image contrasts; Explain how spatial and temporal resolution can be influenced and how to characterize the images generated; Explain which image reconstruction methods are used to generate images; Describe and explain the main clinical uses of the different systems. 	
Skills	 Students are able to: Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required; 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	
	Students can:	
Autonomy	 Understand which physical effects are used in medical imaging; Decide independently for which clinical issue a measuring system can be used. 	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Credit points	6	
Course achievement	None	
Examination	Written exam	
Examination duration		
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Biomedical Engineering: Core qualification: 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 Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory	
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Course L0819: Medical	Imaging Systems
Тур	Lecture
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	 Primary book: 1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press Secondary books: A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003. W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002. H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995. O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Proc	luction Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Cer	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	te (L0310)	Lecture	2	3
Industry 4.0 for engineers (I	L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	th Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	l Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and F	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (I	L0724)	Lecture	2	4
Productivity Management (L	_0928)	Project-/problem-based Learning	2	2
Productivity Management (L	_0931)	Recitation Section (small)	1	1
Feedback Control in Medica	l 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
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L037	9)	Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dy	namics (L0176)	Lecture	2	2
Reliability in Engineering Dy	namics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systen	ns (L0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended	None			
Educational Objectives	After taking part successfully students have read	hed the following learning	results	
Professional		ined are renering rearring	cours	
Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution strategies and new scientific methods in selected areas Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches 			
Personal Competence				
Social Competence	-			
cocia. competence				
Autonomy	Students are able to develop their knowled	ge and skills by autonomo	us election of	courses.
Workload in Hours	Depends on choice of courses			
Credit points	12			
	Product Development, Materials and Product	ion: Specialisation Produ	ct Developm	nent: Elective
Assignment for the	Compulsory			
Following Curricula	Product Development, Materials and Production:	Specialisation Production: E	ective Comp	ulsory
	Product Development, Materials and Production:	Specialisation Materials: Ele	ective Compu	lsory

Course L1592: Applied	Automation
Тур	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
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 L0927: Elements of Integrated Production Systems	
Тур	Project-/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 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 L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
Content	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
	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann L. Leichtbau Rand 1: Elemente", Springer, Berlin, Heidelbarg, oldrighte Auflage
Literature	 Wiedemann, J., "Letchbau Band 1: Elemente", Springer, Berlin, Heideberg, , aktuelle Aultage. 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.

Course L1258: Lightwe	ight Design Practical Course
Тур	Project-/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. 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
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 static 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 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 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
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	Course L0834: Aircraft Design I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and 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: Microsy	stems Technology
Tvp	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	 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 Technologues (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 undercuting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RLE, Bosch process, crop 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 (thermperature measurement, self-generating sensors: Seebeck effect and thermojle; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor; pu junction, NIC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) Mechanical Sensors (glavanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive, plezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) Magnetic Sensors (modulators, DMD, adaptive optics, microscanner, microvalves: passive and active; sensor; microfluidic switching electrokatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscaner, pill, implantable pressure sensor; intelligent osteosynthesis, limplant for spinal cord regeneration) Meiro Actuators, Microfluidics and TAS (drives: thermal, electrostati
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	Project-/problem-based Learning
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. 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

ource 1 0021 - Dreductivity Management		
Course Lossi. Houdet		
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	Prof. Hermann Lödding	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0664: Feedback Control in Medical Technology	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus
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 L1513: Technical Design	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schnittliche Ausarbeitung
and scale	Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
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
	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

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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		Auto & Design,	
(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		Corso Frabcia 161, 10139 Torino, Italia	
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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		Monate , erhältlich am HBF Hamburg	
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		AERO International,	
(erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		Magazin für Zivilluftfahrt	
Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		(erscheint monatlich)	
Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		Aircraft interior international	
(erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		Engl. magasin for Aircraft cabin interior	
aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		(erscheint 2 monatlich)	
Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie		aerotec	
		Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie	
Course L0379: Ceramic	s Technology		
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Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, St	udy 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 proces predominatly on powder-based state and liquid phase). Also, so in powderless forming techniqu be discussed in order to give e specific applications of ceramic	sing with emphasis on advanced structural ceramics. The course focus processing, e.g. "powder-metauurgical techniques and sintering (soild ome aspects of glass and cement science as well as new developments es of ceramics and ceramic composites will be addressed Examples will ingineering students an understanding of technology development and components.	
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
Content		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 C	Ceramics", John Wiley & Sons, New York, 1975	
	ASM Engineering Materials Han	dbook Vol.4 "Ceramics and Glasses", 1991	
Literature	D.W. Richerson, "Modern Ceran	nic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Material	s Testing
Түр	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	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: Reliabili	ty 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: Reliabili	ty of Aircraft Systems
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. 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: M	lechanical Design Methodolo	ogy		
Courses				
Title Mechanical Design Methodo Mechanical Design Methodo	ology (L1523) ology (L1524)	Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning i	results	
Professional Competence				
Knowledge	Science-based working on product desig techniques	n considering targeted application	of specific	product design
Skills	Creative handling of processes used for scientific preparation and formulation of complex product design problems / Application of various product design techniques following theoretical aspects.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	International Management and Engineer Elective Compulsory Mechatronics: Specialisation System Desi Biomedical Engineering: Specialisation Im Biomedical Engineering: Specialisation Im Biomedical Engineering: Specialisation Mi Biomedical Engineering: Specialisation Mi Product Development, Materials and Compulsory Product Development, Materials and Prod Product Development, Materials and Prod Product Development, Materials and Prod Product Development, Materials and Prod Theoretical Mechanical Engineering: Spe Compulsory	ring: Specialisation II. Product Dev gn: Elective Compulsory Artificial Organs and Regene plants and Endoprostheses: Elective edical Technology and Control Theo anagement and Business Administr. Production: Specialisation Produ uction: Specialisation Production: E uction: Specialisation Materials: Ele- recialisation Product Development unical Complementary Course: Elect	rative Med rative Med re Compulso ry: Elective ation: Elective ct Develop lective Compu- ctive Comput- ing Comput-	and Production: icine: Elective ry Compulsory ve Compulsory ment: Elective pulsory ulsory uction: Elective

Course L1523: Mechani	ical Design 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: Mechani	ical Design Methodology
Тур	Recitation Section (small)
Hrs/wk	1
СР	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 M1145: A	utomation 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	NN			
Admission Requirements	None			
Recommended Previous Knowledge	BSc Mechanical Engineering or similar			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	Students can describe the structure an the components, the data transfer via bus systems a	function of process com n programmable logic comp	puters, the outers .	corresponding
	They can describe the basich principle of a nume	ric simulation and the corre	sponding pa	rameters.
Knowledge	Thy can explain the usual method to simulate the	e dynamic behaviour of thre	e-phase ma	chines.
	Students can describe and design simple controll	ers using established meth	odes.	
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.			
Skills	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 phase machines.	or the caclulation of the dyr	namical beha	aviour of three-
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 Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Com Aircraft Systems Engineering: Specialisation Cabi Aircraft Systems Engineering: Specialisation Aircraft Aircraft Systems Engineering: Specialisation Avio International Management and Engineering: Specialisation Avio International Management and Engineering: Specialisation Avio International Management and Engineering: Specialisation Avio Elective Compulsory Mechatronics: Specialisation System Design: Elect Mechatronics: Specialisation Intelligent Systems - Product Development, Materials and Production: Product Development, Materials and Production:	pulsory n Systems: Elective Compu- raft Systems: Elective Comp- nic and Embedded Systems ecialisation II. Aviation Syster- ecialisation II. Aviation Syster- ecialisation II. Product Dev- tive Compulsory and Robotics: Elective Comp- tion: Specialisation Production: E Specialisation Materiale: File	Isory pulsory :: Elective Co Environment ms: Elective velopment a pulsory ct Develop ::lective Comp	ompulsory al Engineering: Compulsory ind Production: ment: Elective pulsory

Course L1525: Automat	tion and Simulation
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	NN
Language	DE
Cycle	SoSe
	Structure of automation systsems
	Aufbau von Automationseinrichtungen
	Structure and function of process computers and corresponding componentes
	Data transfer via bus systems
Contont	Programmable Logic Computers
content	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.
	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag
Literature	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren

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

Module M1156: S	ystems Engineering			
Courses				
Title Systems Engineering (L154 Systems Engineering (L154)	7) 8)	Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof Palf God			
Admission				
Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems			
Educational Objectives	After taking part successfully, students have reach	ed the following learning r	esults	
Professional				
Knowledge	Students are able to: • understand systems engineering process models, methods and tools for the development of complex Systems • describe innovation processes and the need for technology Management • explain the aircraft development process and the process of type certification for aircraft • explain the system development process, including requirements for systems reliability • identify environmental conditions and test procedures for airborne Equipment • value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (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: • understand their responsibilities within a development team and integrate themselves with their role in the overall process			
Autonomy	Students are able to: • interact and communicate in a development tear	n which has distributed ta	sks	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
and scale	120 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: 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 Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory			

Course L1547: Systems	s Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: Innovation processes IP-protection Technology management Systems engineering Aircraft program Certification issues Systems development Safety objectives and fault tolerance Environmental and operating conditions Tools for systems engineering Requirements-based engineering (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: T	urbomachinery		
Courses			
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	Hrs/wk CP 3 4 1 2
Module Responsible	Prof. Franz Joos		
Admission Requirements	None		
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics,	Heat Transfer	
Educational Objectives	After taking part successfully, students have read	ched the following learning	results
Professional Competence	The students can distinguish the physical phenomena of cor 	nversion of energy,	
Knowieage	 understand the different mathematic mod calculate and evaluate turbomachinery. The students are able to	elling of turbomachinery,	
Skills	 - understand the physics of Turbomachinery, - solve excersises self-consistent. 		
Personal Competence	The students are able to		
Social Competence	discuss in small groups and develop an ap	proach.	
Autonomy	 The students are able to develop a complex problem self-consisten analyse the results in a critical way, have an qualified exchange with other stu 	t, dents.	
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56	
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineeri Energy Systems: Specialisation Energy Systems: Product Development, Materials and Produc Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C Theoretical Mechanical Engineering: Specialisation	ng: Elective Compulsory Elective Compulsory tion: Specialisation Produ Specialisation Production: E Specialisation Materials: Ele omplementary Course: Elective on Energy Systems: Elective	Ict Development: Electiv Elective Compulsory ective Compulsory tive Compulsory e Compulsory
Course L1562: Turbom	achines		
Тур	Lecture		

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: 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
СР	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: P	henomena and Methods in Ma	aterials Science		
Courses				
Title Experimental Methods for tl Phase equilibria and transfo	ne Characterization of Materials (L1580) rmations (L1579)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. V	Verkstoffwissenschaft I/I	II	
Educational Objectives	After taking part successfully, students have	e reached the following	learning results	
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence	The students are able to present solutions to	o specialists and to deve	elop ideas further.	
Autonomy	The students are able to • assess their own strengths and weak • gather new necessary expertise by th	nesses. heir own.		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	International Management and Engineering Elective Compulsory Materials Science: Core qualification: Compu Product Development, Materials and Pro Compulsory Product Development, Materials and Produc Product Development, Materials and Produc Theoretical Mechanical Engineering: Technic Theoretical Mechanical Engineering: Special	g: Specialisation II. Pro ulsory oduction: Specialisatio tion: Specialisation Mat cal Complementary Cou lisation Materials Scienc	duct Development a n Product Develop duction: Elective Com erials: Compulsory rse: Elective Compuls e: Elective Compulso	and Production: ment: Elective ipulsory sory iry

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Proc	luction Systems (L0927)	Project-/problem-based	2	3
Emotional Design / User Cer	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	te (L0310)	Lecture	2	3
Industry 4.0 for engineers (I	L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	ith Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	l Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and F	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (I	L0724)	Lecture	2	4
Dreductivity Management (I	0020)	Project-/problem-based	2	2
Productivity Management (I	_0928)	Learning	Z	Z
Productivity Management (L	_0931)	Recitation Section (small)	1	1
Feedback Control in Medica	l 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
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L037	9)	Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dy	namics (L0176)	Lecture	2	2
Reliability in Engineering Dy	namics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft System	ns (L0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended	Nama			
Previous Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution strategies and new scientific methods in selected areas Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches 			
Personal Competence				
Social Competence	-			
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
	Product Development, Materials and Product	ion: Specialisation Produ	ct Developm	nent: Elective
Assignment for the	Compulsory		p	
Following Curricula	Product Development, Materials and Production: S	Specialisation Production: E	lective Comp	ulsory
-	Product Development, Materials and Production: S	Specialisation Materials: Ele	ective Compu	lsory

Course L1592: Applied	Automation
Тур	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
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 L0927: Element	ts of Integrated Production Systems
Тур	Project-/problem-based Learning
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. 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: Develop	Course L1512: Development Management for Mechatronics	
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. 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 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 L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
6	Strength of Laminated Plates
Content	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
	• Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle
Literature	 Auriage. 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.

Course L1258: Lightwe	Course L1258: Lightweight Design Practical Course	
Тур	Project-/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: Mechani	Course L0950: Mechanisms, Systems 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 sícher beurteilen und richtig einsetzen, Vieweg 	

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 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 erogine 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
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	Course L0834: Aircraft Design I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and 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: Microsv	stems Technology
 Tvp	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	 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, opitaxy, 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 undercuting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RLE, Bosch process, Crop process, XE22 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 thermojle; 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 (glavanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) Magnetic Sensors (Intermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, clambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor; Clark electroked, enzyme electrode, DNA chip) Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscaner, mi
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: Product	Course L0928: Productivity Management	
Тур	Project-/problem-based Learning	
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. 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 0931: Product	ourse 1.0021. Broductivity Management	
Tum		
iyp		
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			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Mündliche Prüfung			
Examination duration and scale				
Lecturer	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus			
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: Renewa	ble 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 L1513: Technical Design						
Тур	Lecture					
Hrs/wk	2					
СР	3					
Workload in Hours	ndependent Study Time 62, Study Time in Lecture 28					
Examination Form	Schnittliche Ausarbeitung 10-15 Entwurfszeichnungen Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen, und					
and scale	Entwurfsbegründung)					
Lecturer	Prof. Werner Granzeier					
Language	DE					
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 					
	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					

ARWORLD Design und Architektur für die Flugreise Vitra Design Stiftung Vitra Design Stiftung Perter Desilus Jack Staski te Neues 2005 Technik und Sicherheit von Passagierflugzeugen Frank Litek Motorbuch Verlag 2003 Literature Jeiliner 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-Bertbach, 6104 Seeheim-Jugenheim (erscheint nonatlich) regeman magasin, (erscheint nonatlich) rd möbel interior design, Korradin-Verlag Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen (erscheint monatlich) CAR STYLING, Car Styling Publishing Co. 4-8-16-11F, Ktäshnijuku, Shinjuku-ku, Tokio 160, Japan (erscheint nonatlich) Carsor Factia 161, 10139 Torino, Italia (erscheint vierteljährlich in italienischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH, ALto & Design, Corsor Factaia 161, 10139 Torino, Italia	luction	
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		Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, St	udy 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	
Content		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 Handheek Vol 4. Coromics and Classes", 1001		
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992		
	Skript zur Vorlesung		

Course L0949: Materials Testing				
Түр	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		
Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-01322817 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 35408 VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 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			
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. 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 Mechanical Behaviour of Bri Dislocation Theory of Plastic	ttle Materials (L1661) city (L1662)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3	
Module Responsible	Dr. Erica Lilleodden				
Admission Requirements	None				
Recommended Previous Knowledge	Basics in Materials Science I/II				
Educational Objectives	After taking part successfully, students h	ave reached the following lea	rning results		
Professional Competence					
Knowledge	Students can explain basic principles o thermodynamics (energy minimization, e	f crystallography, statics (fre energy barriers, entropy)	e body diagrams,	tractions) and	
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations				
Personal Competence					
Social Competence	Students can provide appropriate fe constructively.	edback and handle feedba	ck on their own	n performance	
	Students are able to				
	 assess their own strengths and weakne 	sses			
Autonomy	- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.				
	 work independently based on lectures and notes to solve problems, and to ask for help or clarifications when needed 				
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	ı Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	Materials Science: Core qualification: Con Mechanical Engineering and Managemer Product Development, Materials and Compulsory Product Development, Materials and Proo Product Development, Materials and Proo Theoretical Mechanical Engineering: Science	npulsory t: Specialisation Materials: Ele Production: Specialisation duction: Specialisation Product duction: Specialisation Materia cialisation Materials Sciences 1	ective Compulsory Product Develops tion: Elective Com als: Compulsory Elective Compulsory	ment: Elective pulsory	
	Theoretical Mechanical Engineering: Spe	hnical Complementary Course	: Elective Compulso	sory	

Course L1661: Mechani	cal Behaviour 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
	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 l Internal stresses, micro cracks, weight function,
	Heterogeneous materials II Toughening mechanisms: crack bridging, fibres
Content	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
	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
Literature	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: Dislocat	ion Theory of Plasticity
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
	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.
Content	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: C	Pptimal and Robust Control			
Courses				
Title		Turn	Hrc/wk	CP
Optimal and Robust Control	(L0658)	Lecture	пг5/wк 2	3
Optimal and Robust Control	(L0659)	Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	 Classical control (frequency response, roc State space methods Linear algebra, singular value decomposit 	t locus) ion		
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	 Students can explain the significance of problems. They can explain the duality between opt They can explain how the H2 and H performance constraints. They can explain how an LQG design problem. They can explain how model uncertainty controller design They can explain how - based on the sr stability and performance for an uncertain They understand how analysis and synthe linear matrix inequalities. 	of the matrix Riccati equat imal state feedback and opt -infinity norms are used olem can be formulated as s can be represented in a wa mall gain theorem - a robus o plant. ssis conditions on feedback l	ion for the imal state e to represer pecial case ny that lends st controller oops can be	solution of LQ stimation. It stability and of an H2 design is itself to robust can guarantee represented as
Skills	 Students are capable of designing and tui They are capable of representing a H2 or plant, and of using standard software tool They are capable of translating time and constraints on closed-loop sensitivity funce They are capable of constructing an LF designing a mixed-objective robust contro They are capable of formulating analysis (LMI), and of using standard LMI-solvers for They can carry out all of the above using 	hing LQG controllers for mult - H-infinity design problem i s for solving it. frequency domain specifica- tions, and of carrying out a T uncertainty model for ar oller. and synthesis conditions a pr solving them. standard software tools (Ma	tivariable plant the form of ations for comixed-sension uncertain as linear mathematical tab robust of the total tab robust of tab robust	ant models. of a generalized ontrol loops into tivity design. system, and of trix inequalities control toolbox).
Personal Competence				
Social Competence Autonomy	Students can work in small groups on specific pr Students are able to find required information documentation) and use it to solve given problem	oblems to arrive at joint solu in sources provided (lecture ms.	utions. e notes, liter	rature, software
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Er Electrical Engineering: Specialisation Control and Energy Systems: Core qualification: Elective Cor Aircraft Systems Engineering: Specialisation Airc Computational Science and Engineering: Spec Compulsory Mechatronics: Specialisation Intelligent Systems Mechatronics: Specialisation System Design: Ele Biomedical Engineering: Specialisation Artifi Compulsory Biomedical Engineering: Specialisation Implants Biomedical Engineering: Specialisation Medical T Biomedical Engineering: Specialisation Managen Product Development, Materials and Product Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C	agineering: Elective Compuls d Power Systems: Elective C npulsory raft Systems: Elective Com ialisation Systems Engineer and Robotics: Elective Com ctive Compulsory cial Organs and Regene and Endoprostheses: Elective echnology and Control The nent and Business Administr tion: Specialisation Production: E Specialisation Production: E Specialisation Materials: Elec complementary Course: Elective Cation: Elective Computers	sory ompulsory ring and Ro pulsory rative Mec ye Compulso ry: Elective ration: Elective ration: Elective ct Develop Elective Computive Computive Computive Computive	botics: Elective licine: Elective ory Compulsory ve Compulsory ment: Elective upulsory ulsory sory

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 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				
Title Processing of fibre-polymer-	-composites (L1895)	Typ Lecture	Hrs/wk 2	CP 3
From Molecule to Composite	es Part (L1516)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge in the basics of chemistry / p	physics / materials science		
Educational Objectives	After taking part successfully, students	have reached the following learnir	ng results	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes 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.			
	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents matrix) and define the necessary testing and analysis.			
Skills	They can explain the complex structure	-property relationship and		
	the interactions of chemical structure of the polymers, their processing with the different fiber type including to explain neighboring contexts (e.g. sustainability, environmental protection).			rent fiber types,
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of 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.			
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Electiv Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory			

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

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

Module M1343: F	ibre-polymer-composites				
Courses					
Title Typ Structure and properties of fibre-polymer-composites (L1894) Lecture Design with fibre-polymer-composites (L1893) Lecture			Hrs/wk 2 2	CP 3 3	
Module Responsible	Prof. Bodo Fiedler				
Admission Requirements	None				
Recommended Previous Knowledge	Basics: chemistry / physics / materials so	cience			
Educational Objectives	After taking part successfully, students I	have reached the following le	earning results		
Professional Competence	Students can use the knowledge of fibe	er-reinforced composites (FRF) and its constituen	ts to play (fibe	
Knowladaa	/ matrix) and define the necessary testir They can explain the complex relationsh	ng and analysis. Nips structure-property relatio	onship and		
Knowledge	the interactions of chemical structure o including to explain neighboring context	of the polymers, their proces s (e.g. sustainability, enviror	sing with the differ mental protection).	ent fiber types	
Skills	 Students are capable of using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. approximate sizing using the network theory of the structural elements implement and evaluate. selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance. 				
Personal Competence					
Social Competence	 Students can arrive at funded work results in heterogenius groups and document them. provide appropriate feedback and handle feedback on their own performance constructively. 				
	Students are able to				
	 assess their own strengths and weakned 	esses.			
Δυτοποπν	- assess their own state of learning in specific terms and to define further work steps on this basis.				
	- assess possible consequences of their professional activity.				
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	180 min				
Assignment for the Following Curricula	Energy Systems: Core qualification: Elec Aircraft Systems Engineering: Specialisa Aircraft Systems Engineering: Specialisa International Management and Engine Elective Compulsory Materials Science: Specialisation Engine Mechanical Engineering and Managemeu Product Development, Materials and Pro Product Development, Materials and Pro Renewable Energies: Specialisation Bioe Renewable Energies: Specialisation Sola Theoretical Mechanical Engineering: Spe	tive Compulsory tion Cabin Systems: Elective tion Air Transportation Syste ering: Specialisation II. Prod ering Materials: Elective Com nt: Core qualification: Compu Production: Specialisation duction: Specialisation Materialis energy Systems: Elective Con d Energy Systems: Elective Con transport Systems: Elective Con explosion Materials Science energy Systems: Specialisation Materialis energy Systems: Elective Con transport Systems: Elective Con transport Systems: Elective Con exclusion Materials Science energy Systems: Specialisation Materials Science energia Systems: Specialisation Materialis Science energia Systems: Specialisation Materialis Science energia Systems: Specialisation Specialisation Materialis Science energia Systems: Specialisation Speci	Compulsory ms: Elective Compu- luct Development a pulsory lsory Product Develop inction: Elective Com- rials: Compulsory iompulsory iompulsory : Elective Compulsor	ilsory and Production ment: Elective pulsory	

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

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

Module M0563: R	obotics			
Courses				
Title Robotics: Modelling and Cor Robotics: Modelling and Cor	ntrol (L0168) ntrol (L1305)	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 3 3
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics.			
Skille	Students are able to derive and solve equations of motion for various manipulators.			
361115	Students can design linear and partially nonlinear controllers for robotic manipulators.			
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	Students are able to work goal-oriented in sr Students are able to recognize and improve With instructor assistance, students are able course of study.	nall mixed groups. knowledge deficits independent to evaluate their own knowledg	ly. Je level and	define a further
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechanical Engineering and Management: Core qualification: Compulsory Mechatronics: Core qualification: 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: 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 M0771: F	light Physics			
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Courses				
Title Aerodynamics and Flight Me Flight Mechanics II (L0730) Flight Mechanics II (L0731)	echanics I (L0727)	Typ Lecture Lecture Recitation Section (large)	Hrs/wk 3 2 1	CP 3 2 1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation			
Educational Objectives	After taking part successfully, students have read	ached the following learning	results	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy	la deservate et Charles Times O.C. Charles Times in Lead	0.4		
Workload in Hours		lure 84		
Credit points	0 Nano			
Evamination	None Written even			
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification International Management and Engineering: Sp Product Development, Materials and Produ Compulsory Product Development, Materials and Production Product Development, Materials and Production Theoretical Mechanical Engineering: Specialisat Theoretical Mechanical Engineering: Technical	1: Compulsory ecialisation II. Aviation Syste Iction: Specialisation Produ 1: Specialisation Production: I 1: Specialisation Materials: El cion Aircraft Systems Enginee Complementary Course: Elec	ms: Elective Ict Develop Elective Comp ective Comp ering: Electiv tive Compuli	Compulsory ment: Elective pulsory ulsory e Compulsory sory

ırse L0727: Aerodyr	amics and Flight Mechanics I
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
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	
Lecturer	Prof. Frank Thielecke, Mike Montel	
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. Frank Thielecke, Mike Montel	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Typ	Hre/wk	CP
Product Planning (L0951)		Project-/problem-based	7 N K	2
Product Planning Seminar (I	_0853)	Learning Project-/problem-based	2	3
		Learning		
Module Responsible	Prof. Cornelius Herstatt			
Requirements	None			
Recommended Previous Knowledge	Good basic-knowledge of Business Administ	ration		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional				
competence	Students will gain insights into:			
	Product Planning			
	• Process			
Knowledge	 Methods Design thinking 			
	• Process			
	 Methods User integration 			
	Students will gain doon incidets into			
	Students will gain deep insignts into:			
	 Product Planning Process-related aspects 			
Skills	 Organisational-related aspects 			
	 Human-Ressource related aspendices Working-tools, methods and in: 	struments		
	o			
Personal Competence				
	 Interact within a team 			
Social Competence	Raise awareness for globabl issues			
Auton	Gain access to knowledge sources			
Autonomy	 Interpret complex cases Develop presentation skills 			
Workload in Hours	Independent Study Time 110, Study Time in	Locturo 70		
Credit points		Lecture 70		
• • • •	Compulsor B onus Form	Description		
Course achievement	Yes 20 % Subject theoretics	al and .		
Fuendadian	practical work			
Examination Examination duration				
and scale	90 minutes			
	Global Innovation Management: Core qualifi	cation: Compulsory	nualification	Compulsory
	International Management and Engineer	ring: Specialisation I. Electi	ves Manage	ement: Electiv
	Compulsory Mechanical Engineering and Management: S	pecialisation Management [,] Ele	ctive Compu	lsorv
Assignment for the	Product Development, Materials and Pr	oduction: Specialisation Proc	luct Develop	oment: Electiv
Following Curricula	Compulsory Product Development, Materials and Product	tion: Specialisation Production:	Elective Com	npulsory
	Product Development, Materials and Product	tion: Specialisation Materials: E	lective Comp	oulsory
	Compulsory	ialisation Product Developme	nic and Prod	uction: Electiv
	Theoretical Mechanical Engineering: Technic	al Complementary Course: Ele	ctive Compul	sorv

Course L0851: Product	Planning
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	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 Voluntary presentations in the third hour (articles / case studies) - Guest lectures by researchers - Lecture on Sustainability with frequent reference to current research - Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

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

Module M0830: E	nvironmental Protection and M	lanagement		
Courses				
Title Integrated Pollution Control Health, Safety and Environr Health, Safety and Environr	(L0502) nental Management (L0387) nental Management (L0388)	Typ Lecture Lecture Recitation Section (small)	Hrs/wk 2 2 1	CP 2 3 1
Module Responsible				
Admission	News			
Requirements	None			
Recommended Previous Knowledge	 Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) Good knowledge of the relevant Environmental Legislation Basic knowledge of instruments for Environmental Assessment 			
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, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.			
Skills	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.			
Personal Competence	The students can work together in international groups.			
Social Competence				
Autonomy	Students are able to organize their work flow to prepare themselves 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 I	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core qualification: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: 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 Production: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory			

Course L0502: Integrat	ed 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
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 Environmental Management
Тур	Lecture
Hrs/wk	2
СР	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,	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		

	roduction Planning & Control and	Digital Enterprise		
Courses				
Title The Digital Enterprise (L0932) Production Planning and Control (L0929) Production Planning and Control (L0930) Exercise: The Digital Enterprise (L0933)		Typ Lecture Lecture Recitation Section (small) Recitation Section (small)	Hrs/wk 2 2 1 1	CP 2 2 1 1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Production and Quality Managem	lent		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence Knowledge Skills	Students can explain the contents of the module in detail and take a critical position to them. Students are capable of choosing and applying models and methods from the module to industrial			
Personal Competence Social Competence Autonomy	Students can develop joint solutions in mixed teams and present them to others.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

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

Course L0929: Production Planning and Control	
Тур	Lecture
Hrs/wk	2
СР	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	
	Siehe korrespondierende Vorlesung	
Literature	See interlocking course	

Module M0962: S	ustainability and Risk Ma	nagement		
Courses				
Title Safety, Reliability and Risk / Environment and Sustainab	Assessment (L1145) ility (L0319)	Typ Seminar Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, studen	ts have reached the following lea	arning results	
Professional Competence				
Knowledge	 assessment as well as environmental basics in safety and reliability of safety and reliability analysis n risk assessment Production and usage of bio-ch energy production and supply sustainable product design 	and sustainable engineering, in of technical facilities nethods ar	detail:	
Skills	Students are able apply interdis sustainability reporting. They can ev feasible treatment concepts.	ciplinary system-oriented met aluate the effort and costs for p	hods for risk as processes and sele	ssessment and ct economically
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the s Furthermore, they can define targe management and sustainability conc impact.	subject area from given sources ats for new application or res- epts accordance with the poter	and transform it to earch-oriented dui ntial social, econor	new questions. ties in for risk nic and cultural
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 min	utes in groups)		
Assignment for the Following Curricula	Civil Engineering: Core qualification: O International Management and Engine Product Development, Materials a Compulsory Product Development, Materials and Product Development, Materials and Water and Environmental Engineering	Compulsory eering: Specialisation II. Civil Eng nd Production: Specialisation Production: Specialisation Produc Production: Specialisation Materi g: Core qualification: Compulsory	gineering: Elective Product Develop ction: Elective Com als: Elective Comp /	Compulsory ment: Elective pulsory ulsory

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	
СР	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, waster 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	
1	Wird in der Veranstaltung hekannt gegeben	
Literature	wird in der Veranstallung bekännt gegeben.	

Module M1155: A	ircraft Cabin Systems			
Courses				
Title Aircraft Cabin Systems (L15 Aircraft Cabin Systems (L15	45) 46)	Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	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 Systems 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 discus	ss their ideas with experts		
Autonomy	Students are able to: • Reflect the contents of lectures and expert pres-	entations self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L1545: Aircraft Cabin Systems		
Тур	Lecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Ralf God	
Language	DE	
Cycle	WiSe	
	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.	
Content	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
СР	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: L	aser systems and metho	ds of manufacturing	design and analy	sis
Courses				
Title Laser Systems and Process Methods for Analysing Produ	Technologies (L1612) uction Processes (L0876)	Typ Lecture Lecture	Hrs/wk Cl 2 3 2 3	Þ
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, stude	nts 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			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development, Materials Compulsory Product Development, Materials and Product Development, Materials and Theoretical Mechanical Engineering Compulsory Theoretical Mechanical Engineering:	and Production: Specialisation Production: Specialisation Pro Production: Specialisation Mat g: Specialisation Product Dev Technical Complementary Cou	on Product Developmen duction: Compulsory terials: Elective Compulsor velopment and Productio urse: Elective Compulsory	t: Elective Y n: Elective

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	s for Analysing Production Processes
Тур	Lecture
Hrs/wk	2
СР	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 M1342: P	olymers			
Courses				
Title Structure and Properties of Processing and design with	Polymers (L0389) polymers (L1892)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous Knowledge	Basics: chemistry / physics / material sciene	ce		
Educational Objectives	After taking part successfully, students hav	e reached the following l	earning results	
Professional				
competence	Students can use the knowledge of plastics	and define the necessar	y testing and analys	s.
	They can explain the complex relationships	structure-property relati	onship and	
Knowledge	the interactions of chemical structure of the sustainability, environmental protection).	ne polymers, including to	explain neighboring	g contexts (e.g.
	Students are capable of			
Skills	 using standardized calculation methods strength) to calculate and evaluate the difference 	s in a given context to erent materials.	mechanical prope	rties (modulus,
	 selecting appropriate solutions for me corrosion resistance. 	chanical recycling probl	ems and sizing exa	mple stiffness,
Personal Competence				
	Students can			
	- arrive at funded work results in heterogen	nius groups and documen	t them.	
Social Competence	- provide appropriate feedback and handle	feedback on their own pe	erformance construc	tively.
	Students are able to			
	- assess their own strengths and weakness	es.		
Autonomy	- assess their own state of learning in specific terms and to define further work steps on this basis.			
	- assess possible consequences of their professional activity.			
		· · · · · · · · · · · · · · · · · · ·		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Course achievement	o None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Ja Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory			

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

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

Module M0812: A	ircraft Design			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Design I (L0820) Aircraft Design I (L0834)		Lecture Recitation Section (large)	2	2
Aircraft Design II (Conceptus	al Design of Rotorcraft, special operations aircraft, UAV)	Lecture	2	2
(L0844) Aircraft Design II (Conceptus (L0847)	al Design of Rotorcraft, special operations aircraft, UAV)	Recitation Section (large)	1	1
Module Responsible	Prof. Volker Gollnick			
Admission Requirements	None			
Recommended Previous Knowledge	 Bachelor Mech. Eng. Vordiplom Mech. Eng. Module Air Transport Systems 			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	 Principle understanding of integrated aircraft design Understanding of the interactions and contributions of the various disciplines Impact of the relevant design parameter on the aircraft design Introduction of the principle design methods 			
	Understanding and application of design and calcul	lation methods		
Skills	Understanding of interdisciplinary and integrative i	nterdependencies		
Personal Competence				
	Working in interdisciplinary teams			
Social Competence	Communication			
Autonomy	Organization of workflows and -strategies			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory			
Course L0930, Aires ft	Decimal			
Course LU820: Aircraft				
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture	28		
Lecturer	Prof. Volker Gollnick			

Language	DE
Cycle	WiSe
Content	 Introduction into the aircraft design process 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
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
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
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 L0844: Aircraft	Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV)
Түр	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Gollnick, Dr. Bernd Liebhardt
Language	DE/EN
Cycle	SoSe
Content	Take Off and landing Loads on Aircraft Operation Cost Principles of Rotorcraft Design Principles of high performance aircraft design Principles of special operations aircraft design Principles of Unmanned Air Systems design
Literature	Gareth Padfield: Helicopter Flight Dynamics Raymond Prouty: Helicopter Performance Stability and Control Klaus Hünecke: Das Kampfflugzeug von Heute

ourse L0847: Aircraft	rse L0847: Aircraft Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV)	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Volker Gollnick, Dr. Bernd Liebhardt	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1185: Specific Regulation	Technical Complementary Course for PEPMS (according to Subject ons)
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	See selected module according to FSPO
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	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

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tems (L2329) tems (L2331) tems (L2330) : (L1591) : (L1738) f. Thorsten Schüppstuhl ne nout major course assessment er taking part successfully, students hav dents • know the characteristic components	Typ Lecture Project-/problem-based Learning Recitation Section (small) Lecture Recitation Section (small) Lecture Recitation Section (small)	Hrs/wk 4 1 1 2 1 2 1 2 1 end for the second	CP 4 1 2 1 2 1
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know the characteristic components			
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 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 controllers design of circuit for pneumatic applications 			
dents 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 decisions. 		nical level and	
 Students are able to analyze automation tasks independently generate programs for robots and programmable logic devices autonomously develop solutions for practice oriented tasks of automation independently design safety concepts for automation applications assess consequences of their professional actions and responsibilities 			
ependent Study Time 12, Study Time in	Lecture 168		
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course L2329: Automation Technology and Systems	
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2331: Automation Technology and Systems		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2330: Automation Technology and 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	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1591: Handling and Assembly Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
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	See interlocking course
Literature	See interlocking course

Course L1	Course L1590: Automation Technology		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
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 tren -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 L1	Course L1739: Automation Technology		
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	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		

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 Systems I				
Courses				
Title Aircraft Systems I (L0735) Aircraft Systems I (L0739)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: Mathematics Mechanics Thermodynamics Electrical Engineering Hydraulics Control Systems			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Knowledge	 Students are able to: Describe essential components and design points of hydraulic, electrical and high-lift systems Give an overview of the functionality of air conditioning systems Explain the need for high-lift systems such as ist functionality and effects Assess the challenge during the design of supply systems of an aircraft 			
Skills	 Students are able to: Design hydraulic and electric supply systems of aircrafts Design high-lift systems of aircrafts Analyze the thermodynamic behaviour of air conditioning systems 			
Personal Competence	Students are able to:			
Social Competence	 Perform system design in groups and prese 	nt and discuss results		
Autonomy	Students are able to: • Reflect the contents of lectures autonomous	sly		
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re /U		
Credit points	Nene			
Course achievement	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	 The orbit of the product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory 		Compulsory ment: Elective pulsory alsory ory e Compulsory	

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; electrica 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)
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 M0867: Production Planning & Control and Digital Enterprise				
Courses				
Title The Digital Enterprise (L093 Production Planning and Co Production Planning and Co Exercise: The Digital Enterp	82) ntrol (L0929) ntrol (L0930) rise (L0933)	Typ Lecture Lecture Recitation Section (small) Recitation Section (small)	Hrs/wk 2 2 1 1	CP 2 2 1 1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Production and Quality Managem	ent		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence Knowledge Skills	Students can explain the contents of the module in detail and take a critical position to them. Students are capable of choosing and applying models and methods from the module to industrial			
Personal Competence Social Competence Autonomy	Students can develop joint solutions in mixed teams and present them to others.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	ation Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Product Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elect 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: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elec Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Electory Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		and Production: ompulsory icine: Elective ry Compulsory ulsory ment: Elective ulsory uction: Elective	

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

Course L0929: Production Planning and Control		
Тур	ecture	
Hrs/wk	2	
СР	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
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 systems and methods of manufacturing design and analysis				
Courses				
Title Laser Systems and Process Methods for Analysing Produ	Technologies (L1612) uction Processes (L0876)	Typ Lecture Lecture	Hrs/wk C 2 3 2 3	Ρ
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following	learning results	
Professional Competence Knowledge				
Personal Competence Social Competence Autonomy				
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development, Materials a Compulsory Product Development, Materials and Product Development, Materials and Theoretical Mechanical Engineering Compulsory Theoretical Mechanical Engineering:	and Production: Specialisati Production: Specialisation Pro Production: Specialisation Ma : Specialisation Product De Technical Complementary Co	on Product Developmen oduction: Compulsory terials: Elective Compulso velopment and Productio urse: Elective Compulsory	nt: Elective ry on: Elective

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 		
 Hügel, H., T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, Svieweg + Teubner Wiesbaden 2014. Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springe Berlin Heidelberg 2010. Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag Londor J.C. Ion: Laser processing of engineering materials: principles, procedure and in 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	
СР	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: A	utomation Technology and	l Systems		
Courses				
Title Automation Technology and Systems (L2329)		Typ Lecture	Hrs/wk 4	CP 4
Automation Technology and	l Systems (L2331)	Learning	1	1
Automation Technology and	Systems (L2330)	Recitation Section (small) 1	1
Handling and Assembly Sys	tems (L1591) tems (L1738)	Lecture Recitation Section (small	2	2
Automation Technology (L1	590)	Lecture	2	2
Automation Technology (L1	739)	Recitation Section (small) 1	1
Module Responsible	Prof. Thorsten Schüppstuhl			
Admission Requirements	None			
Recommended	without major course assessment			
Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning	g results	
Professional Competence				
competence	Students			
Knowledge	 know the characteristic components of an automation systems and have good understanding of their interaction know methods for a systematical analysis of automation tasks and are able to use them have special competences in industrial robot based automation systems 			
Skills	 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 controllers 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 decisions.			
Autonomy	Students are able to analyze automation tasks independently generate programs for robots and programmable logic devices autonomously develop solutions for practice oriented tasks of automation independently design safety concepts for automation applications assess consequences of their professional actions and responsibilities			
Workload in Hours	Independent Study Time 12, Study Tim	e in Lecture 168		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration	120 min			
Assignment for the Following Curricula	Product Development, Materials an Compulsory Product Development, Materials and Pr Product Development, Materials and Pr Theoretical Mechanical Engineering: Te Theoretical Mechanical Engineering: Compulsory	d Production: Specialisation Proc oduction: Specialisation Production: oduction: Specialisation Materials: E chnical Complementary Course: Ele Specialisation Product Developme	luct Develop Compulsory Elective Compu active Compul nt and Prod	oment: Elective pulsory lsory uction: Elective

Course L2329: Automation Technology and Systems		
Lecture		
4		
4		
Independent Study Time 64, Study Time in Lecture 56		
Prof. Thorsten Schüppstuhl		
DE		
SoSe		

Course L2331: Automation Technology and Systems		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2330: Automation Technology and 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	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1591: Handling and Assembly Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
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	See interlocking course	
Literature	See interlocking course	

Course L1	590: Automation Technology		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
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		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	r Prof. Thorsten Schüppstuhl		
Language	e DE		
Cycle	SoSe		
Content	 Introduction to the production Automation including their different fields of application, importent terms, automation history 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 	y and 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		

Module M1193: Cabin Systems Engineering				
Courses				
Title Computer and communicati Computer and communicati	on technology in cabin electronics and avionics (L1557) on technology in cabin electronics and avionics (L1558)	Typ Lecture Recitation Section (small)	Hrs/wk 2 1	CP 2 1
Model-Based Systems Engin	eering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering			
Educational Objectives	After taking part successfully, students have reach	ed the following learning i	results	
Professional				
Knowledge	e 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 network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a <i>Isl</i> 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 • elaborate partial results and merge with others to form a complete solution				
Autonomy	Students are able to: Autonomy • organize and schedule their practical tasks			
Workload in Hours	Independent Study Time 96, Study Time in Lecture			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	20 minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory Assignment for the Product Development, Materials and Production: Specialisation Product Development: Elective Following Curricula 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory		lsory Compulsory ment: Elective pulsory Jlsory ory e Compulsory	

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 communication 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	Project-/problem-based Learning	
Hrs/wk	3	
СР	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: E	lectricity Generation from W	/ind and Hydro Powe	er	
Courses				
Title Renewable Energy Projects Hydro Power Use (L0013) Wind Turbine Plants (L0011) Wind Energy Use - Focus Of	in Emerged Markets (L0014)) fshore (L0012)	Typ Project Seminar Lecture Lecture Lecture	Hrs/wk 1 1 2 1	CP 1 1 3 1
Module Responsible	Dr. Joachim Gerth			
Admission	None			
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Technical Thermodynamics II, Module: Fundamentals of Fluid Mechanics	5	· · · · · · · · · · · · · · · · · · ·	
Educational Objectives	After taking part successfully, students ha	ave reached the following lear	ning results	
Professional Competence Knowledge	By ending this module students can expla of wind energy use in offshore condition current developments. Furthermore, they generate electricity. The students reprodu renewable energy projects in countries ou	ain in detail knowledge of wind s and can critical comment th are able to describe fundame uce and explain the basic prod utside Europe.	I turbines with a nese aspects in ntally the use of cedure in the im	particular focus consideration of water power to plementation of
	Through active discussions of various top understanding and the application of the have learned in practice.	pics within the seminar of the theoretical background and ar	module, studen e thus able to tra	ts improve their ansfer what they
Skills	Students are able to apply the acquired systems and evaluate and assess technic and operation of these energy systems. implementation of renewable energy pro approach in Europe and can apply this pro	d theoretical foundations on e cally the resulting relationship: They can in compare critical jects in countries outside Euro ocedure on exemplary theoret	exemplary water s in the context y the special pr ope with the in p ical projects.	or wind power of dimensioning ocedure for the principle applied
Personal Competence Social Competence	Students can discuss scientific tasks subj	jet-specificly and multidisciplir	ary within a sem	ninar.
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material nomy clear the contents of the lecture and to acquire the particular knowledge about the subject area.		ture material to ect area.	
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotechr Civil Engineering: Specialisation Coastal E Energy and Environmental Engineering: S International Management and Engineeri International Management and Engineeri Elective Compulsory Product Development, Materials and Compulsory Product Development, Materials and Prod Product Development, Materials and Prod Renewable Energies: Core qualification: C Theoretical Mechanical Engineering: Spec Process Engineering: Specialisation Enviro Water and Environmental Engineering: C	al Engineering: Elective Compu- nical Engineering: Elective Com Engineering: Elective Compulso ipecialisation Energy Engineering: Specialisation II. Renewabl- ing: Specialisation II. Renewabl- ing: Specialisation II. Energy a Production: Specialisation Producti luction: Specialisation Producti luction: Specialisation Material Compulsory nical Complementary Course: cialisation Energy Systems: Ele pomental Process Engineering: pecialisation Cities: Elective Co	Ilsory npulsory ory ing: Elective Con e Energy: Electiv and Environmen Product Develop on: Elective Comp s: Elective Compulsor : Elective Compulsor : Elective Compulsory : Elective Compu	npulsory re Compulsory tal Engineering: oment: Elective npulsory rulsory sory y lsory

course coorte. Renewa	Course L0014: Renewable Energy 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	Prof. Andreas Wiese		
Language	DE		
Cycle	SoSe		
Content	 Introduction Development of renewable energies worldwide 		

Literature Folien der Vorlesung

Course L0013: Hydro Power Use		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. 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 Tu	rbine Plants	
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Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann	
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 En	ergy Use - Focus 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 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

Module M0630: R	obotics and I	lavigation	in Medicin	e		
Courses						
Title Robotics and Navigation in Robotics and Navigation in Robotics and Navigation in	Medicine (L0335) Medicine (L0338) Medicine (L0336)			Typ Lecture Project Seminar Recitation Section (sma	Hrs/wk 2 2 all) 1	CP 3 2 1
Module Responsible	Prof. Alexander Scl	ılaefer				
Admission Requirements	None					
Recommended Previous Knowledge	 principles of principles of solid R or Ma 	math (algebra, programming, e atlab skills	analysis/calculu e.g., in Java or C	s) +++		
Educational Objectives	After taking part su	ccessfully, stud	ents have reach	ed the following learni	ing results	
Professional Competence						
Knowledge	The students can and their compon safety and regulati	explain kinemat ents in detail. S ons. Students ca	ics and tracking Systems can be an assess typica	g systems in clinical c e evaluated with resp l systems regarding de	ontexts and il ect to collision esign and limit	lustrate systems n detection and tations.
Skills	The students are applications.	able to design	and evaluate n	avigation systems an	d robotic syst	ems for medica
Personal Competence	İ					
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work.					
Autonomy	The students can r results in an appro	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.				
Workload in Hours	Independent Study	Time 110, Stud	y Time in Lectu	re 70		
Credit points	6					
Course achievement	CompulsorBonusYes10 %Yes10 %	Form Written ela Presentatio	aboration on	Description		
Examination	Written exam					
Examination duration and scale	90 minutes					
Assignment for the Following Curricula	Computer science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Electiv Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Electiv Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Electiv 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 Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory					

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Course L0335: Robotics	s 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	s 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 M0996: S	upply Chain Ma	anagement				
Courses						
Title			-	Typ	Hrs/wk	СР
Supply Chain Management	(L1218)		i I	Learning	3	4
Value-Adding Networks (L11	190)		I	Lecture	2	2
Module Responsible	Prof. Thorsten Blecke	r				
Admission Requirements	None					
Recommended	no					
Previous Knowledge	After taking part cure	accfully ctudents	have reache	d the following learning	roculto	
Professional	After taking part succ	essiully, students	nave reache	a the following learning	j results	
Competence						
Knowledge	 Theoretical Approac Theoretical Approac to identify fields of a reasons for the for (transaction cost thee Selected approache to elected approache to understand the relationships. to explain and catege to explain and catege advantages and dis the two terms . to state criteria/ far (total network costs). to explain methods to interpret phenoty. recognize relationsis models. to categorise specipractical examples of 	he giobalization al shes and methods decision in SCM . ormation of netw pry, principal-agen is to explain the di- of network format e functional me gorize relationship ng concepts and e advantages of offs ctors/ parameters for location findin ypes of production hips between R & ems with the con- of appropriate ap- al waste logistics good networking.	in logistics a vorks based totheory, pro evelopment of evelopment of so within netw explain motiv shoring and o s that influen- ing/evaluation. networks. D and produ- nfiguration of oproaches. s including th	on various theories f perty-right theory) and of networks. f inter-organizational vorks. res/ barriers or advanta butsourcing and to illus ce production location uction and their location f logistics networks (on heir duties & objective	examples fro jement and u rom instituti the resource and interna ges and disa trate the dist decisions at ons and to de distribution a s and to sta	the global level escribe coherer and spare part te and describ
Skills	 to asses trends and their consequences for to evaluate, anaylse to anaylse partners to select sourcing c advantages and disad to evaluate location to recognize relation the suitability of spection to anaylse concepts to design subcontration to alopt methods of 	challenges in hat or companies. e and systematise and their suitabili oncepts for specifi dvantages of each decisions for prod inships between F ific models for diff yzed concepts to i uate the product of of Information ar cting, procuremer efficient and flow-of f complexity mana	tional and int networks an ity for co-ope ic products / approach. duction and F & D and pr ferent situation international development ad communic nt, production priented ente agement and	ernational supply chair d network relations bas ration in collaborations product components bas & & D based on concept oduction as well as the ons. practices. processes. ation management in l n and disposal as well a rprise networks. risk management in lo	is and logistic and coopera ased on the le cs. eir locations ogistics. is R & D netw gistics.	cs networks an cture. tive relations. ecture as well a and to evaluat rorks to shape,
Personal Competence						
Social Competence	 to evaluate intercul advance planning in the lecture. definition of procum networks. design of the procu and core competencie to make decision o and buying/selling ma D. Decision on R & D I the selection of an ap 	tural and internati and design of net ement strategies urement network (es, as well as on tl f location for proc arkets, which were ocations based or propriate model.	ional relation work formati for individual (external/inte he findings of duction taking e also discuss n the insights	ships based on discuss on and their objectives I parts using the gaine ernal/modules etc.) bas f the case studies. g into account global c sed in the case studies s gained from case stud	ed case studi based on co d knowledge ed on the so ontexts, eva and their dep dies / practica	es. ntent discusse of procuremer urcing concept luation method endence on R al examples an
Autonomy	After completing the Chain Management a	module students	s are capable quired knowl	e to work independent edge to new problems.	tly on the su	bject of Suppl
Workload in Hours	Independent Study Ti	me 110, Study Tir	me in Lecture	2 70		
Credit points	6	East		Description		
Course achievement	No 15 %	Form Subject theo practical work	oretical and	Jim Rahmen der Lehry Management"	veranstaltung	"Supply Chair
Examination	Written exam	•		-		
Examination duration	120 min					
and scale						:
Assignment for the Following Curricula	International Manag Compulsory Logistics, Infrastructu Product Developmer Compulsory Product Development	ement and Eng re and Mobility: S nt, Materials and r, Materials and Pr	yineering: Sy pecialisation d Productior oduction: Spe	pecialisation I. Electi Production and Logistic 1: Specialisation Prod ecialisation Production:	ves Manage cs: Elective C luct Develop Elective Com	ement: Electiv ompulsory oment: Electiv npulsory

Product Development, Materials and Production: Specialisation Materials: Elective Compulsory

Course Lizio. Supply C	nain Management
Тур	Project-/problem-based Learning
Hrs/wk	3
CP 4	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer F	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 a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods
Literature F Literature S S S S S S S S S S S S S S S S S S S	 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-A	dding Networks
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	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 M0764: A	vircraft Systems II			
Courses				
Title		Typ	Hrs/wk	CP
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	 describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. explain different configurations and designs and their origins explain atmospheric conditions for icing such as the functionality of anti-ice systems 			
Skills	 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				
	Students are able to:			
Social Competence	Develop joint solutions in mixed teams			
	Students are able to:			
Autonomy	 derive requirements and perform appro systems from complex issues and circumstand 	priate yet simplified des ances in a self-reliant man	sign process ner	ses for aircraft
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: C International Management and Engineering: Speci. Product Development, Materials and Productio Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Technical Cor Theoretical Mechanical Engineering: Specialisation	compulsory alisation II. Aviation Syster on: Specialisation Produ pecialisation Production: E pecialisation Materials: Ele nplementary Course: Elect A kircraft Systems Enginee	ms: Elective (ct Developr Elective Compu ective Compuls ring: Elective	Compulsory nent: Elective pulsory ilsory ory 2 Compulsory

Course L0736: Aircraft	Systems II
Тур	Lecture
Hrs/wk	3
СР	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) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
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: M	ledical Imaging Systems		
Courses			
Title Medical Imaging Systems (L	.0819) Typ Lecture	Hrs/wk 4	CP 6
Module Responsible	Dr. Michael Grass		
Admission Requirements	None		
Recommended Previous Knowledge	none		
Educational Objectives	After taking part successfully, students have reached the following learni	ng results	
Professional Competence			
Knowledge	 Students can: Describe the system configuration and components of the main clinical imaging systems; Explain how the system components and the overall system of the imaging systems function; Explain and apply the physical processes that make imaging possible and use with the fundamental physical equations; Name and describe the physical effects required to generate image contrasts; Explain how spatial and temporal resolution can be influenced and how to characterize the images generated; Explain which image reconstruction methods are used to generate images; Describe and explain the main clinical uses of the different systems. 		
Skills	 Students are able to: Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required; 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		İ
	Students can:		
Autonomy	 Understand which physical effects are used in medical imaging; Decide independently for which clinical issue a measuring system 	can be used.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration			
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Comp Biomedical Engineering: Core qualification: Compulsory Product Development, Materials and Production: Specialisation Pro Compulsory Product Development, Materials and Production: Specialisation Productio Product Development, Materials and Production: Specialisation Materials: Theoretical Mechanical Engineering: Technical Complementary Course: E Theoretical Mechanical Engineering: Specialisation Bio- and Medical Tech	ulsory oduct Develop n: Elective Com Elective Compul lective Compul nology: Elective	ment: Elective pulsory ulsory sory e Compulsory

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

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Proc	duction Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Ce	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	ce (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	ith Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	l Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and I	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (I	L0928)	Project-/problem-based Learning	2	2
Productivity Management (I	L0931)	Recitation Section (small)	1	1
Feedback Control in Medica	l 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
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L037	(9)	Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dy	ynamics (L0176)	Lecture	2	2
Reliability in Engineering Dy	ynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft System	ns (L0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended	None			
Previous Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution strategies and new scientific methods in selected areas Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches 			
Personal Competence				
Social Competence	-			
Social competence				
Autonomy	Students are able to develop their knowled	ge and skills by autonomo	us election of	courses.
Workload in Hours	Depends on choice of courses			
Credit points	12			
	Product Development, Materials and Product	ion: Specialisation Produ	ct Developm	nent: Elective
Assignment for the	Compulsory			1.000.00
Following Curricula Product Development, Materials and Production: Specialisation Production: Elective Compulsory		ulsory		
_	Product Development, Materials and Production:	Specialisation Materials: Ele	ective Compu	lsory

Course L1592: Applied Automation		
Тур	Project-/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 Minuten	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy	
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992	

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

Course L0927: Element	s of Integrated Production Systems
Тур	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
	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.
Literature	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 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 L2012: Industry 4.0 for engineers		
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 min	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1514: Lightwe	ight Construction with Fibre Reinforced Rolymers - Structural Mechanics
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
Content	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
	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.
Literature	 Reday, 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.

Course L1258: Lightweight Design Practical Course		
Тур	Project-/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. Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsev 2005. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., Münchn Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUH TuTech Innovation GmbH, 2005. 	

Course L0950: Mechanisms, Systems 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 sícher beurteilen und richtig einsetzen, Vieweg

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 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
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
СР	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: Microsys	stems Technology
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	 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 undercuting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, crop process, XE2 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: thermo reistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile; modulating sensors: subcave, capacitive and fabrication process; accelerometer; leizoresistive, 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 magnetomagnetic, Sensors, pul-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) Chemical and Bio Sensors (thermal gas sensors; pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, parapit sensor; pass sensor, lambda probe, MOSF
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	Project-/problem-based Learning
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. 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 0931: Product	Course 10021, Deeductivity Management	
Tum		
iyp		
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	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus	
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 L1513: Technica	al Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung 10.15 Entwurfszeichnungen Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen, und
and scale	Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	
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
	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

laction	
	AIRWORLD
	Design und Architektur für die Flugreise
	Vitra Design Stiftung Weil am Rhein 2004
	Airline Design
	Perter Deslius Jacek Slaski te Neues 2005
	Technik und Sicherheit von Passagierflugzeugen
	Frank Littek
	Motorbuch Verlag 2003
Literature	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: Ceramic	s Technology		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, St	udy 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 proces predominatly on powder-based state and liquid phase). Also, si in powderless forming techniqu be discussed in order to give e specific applications of ceramic	sing with emphasis on advanced structural ceramics. The course focus processing, e.g. "powder-metauurgical techniques and sintering (solid ome aspects of glass and cement science as well as new developments es of ceramics and ceramic composites will be addressed Examples will ingineering students an understanding of technology development and components.	
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
Content		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		
Literature	D.W. Richerson, "Modern Ceran	nic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Material	s Testing
Typ	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: Reliabili	ty 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: Reliabili	ty of Aircraft Systems
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. 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: M	lechanical Design Method	blogy		
Courses				
Title Mechanical Design Methodo Mechanical Design Methodo	ology (L1523) ology (L1524)	Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	Science-based working on product de techniques	sign considering targeted application	of specific	product design
Skills	Creative handling of processes used for scientific preparation and formulation of complex product design problems / Application of various product design techniques following theoretical aspects.			
Personal Competence				
Social Competence	•			
Autonomy	1			
Workload in Hours	Independent Study Time 124, Study Ti	me in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	International Management and Engin Elective Compulsory Mechatronics: Specialisation System D Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Product Development, Materials and P Product Development, Materials and P Product Development, Materials and P Theoretical Mechanical Engineering: Compulsory Theoretical Mechanical Engineering: Theoretical Mechanical Engineering: Specialisation Product Development, Materials and P	eering: Specialisation II. Product De- esign: Elective Compulsory ion Artificial Organs and Regene Implants and Endoprostheses: Electiv Medical Technology and Control Theo Management and Business Administr d Production: Specialisation Produ- roduction: Specialisation Production: E oduction: Specialisation Materials: Ele- Specialisation Product Development echnical Complementary Course: Election	velopment a rative Med ve Compulso pry: Elective ation: Elective ct Develop Elective Comput t and Produ	and Production: icine: Elective ry Compulsory ve Compulsory ment: Elective pulsory ulsory uction: Elective

Course L1523: Mechan	ical Design 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	1	
СР	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 M1145: A	utomation 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	NN				
Requirements	None				
Recommended Previous Knowledge	BSc Mechanical Engineering or simi	lar			
Educational Objectives	After taking part successfully, students	have reached the following learning	results		
Professional Competence					
	Students can describe the structure components, the data transfer via bus s	an the function of process com systems an programmable logic comp	puters, the outers .	corresponding	
<i></i>	They can describe the basich principle o	of a numeric simulation and the corre	sponding p	arameters.	
ĸnowieage	Thy can explain the usual method to simulate the dynamic behaviour of three-phase machines.				
	Students can describe and design simpl	e controllers using established metho	odes.		
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.				
Skills	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 these analysisis in an adequate manner	of methocic analysises in the field of und to evaluate the results critically	automatior	n systems, to do	
Workload in Hours	Independent Study Time 110, Study Tin	ne in Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 2	L Stunde			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elec Aircraft Systems Engineering: Specialisa Aircraft Systems Engineering: Specialisa Aircraft Systems Engineering: Specialisa International Management and Enginee Elective Compulsory International Management and Enginee Elective Compulsory Mechatronics: Specialisation System De Mechatronics: Specialisation System De Mechatronics: Specialisation Intelligent Product Development, Materials and Pro Compulsory Product Development, Materials and Pro	ctive Compulsory ation Cabin Systems: Elective Compu ation Aircraft Systems: Elective Comp ation Avionic and Embedded Systems ering: Specialisation II. Energy and E ring: Specialisation II. Aviation Syster ering: Specialisation II. Product Dev sign: Elective Compulsory Systems and Robotics: Elective Comp I Production: Specialisation Production: E eduction: Specialisation Production: E	lsory ulsory :: Elective C Environmen ns: Elective velopment pulsory ct Develop lective Com	ompulsory tal Engineering: Compulsory and Production: pment: Elective	

Course L1525: Automat	tion and Simulation	
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	NN	
Language	DE	
Cycle	SoSe	
	Structure of automation systsems	
	Aufbau von Automationseinrichtungen	
	Structure and function of process computers and corresponding componentes	
	Data transfer via bus systems	
Contont	Programmable Logic Computers	
content	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.	
	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag	
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag	
Literature	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag	
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren	

Course L1527: Automation and Simulation		
Recitation Section (large)		
2		
3		
Independent Study Time 62, Study Time in Lecture 28		
NN		
DE		
SoSe		
See interlocking course		
See interlocking course		

Module M1156: S	ystems Engineering			
Courses				
Title Systems Engineering (L154	7)	Typ Lecture	Hrs/wk	CP 4
Systems Engineering (L154	o)	Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional				
competence	Students are able to:			
Knowledge	 understand systems engineering process models, methods and tools for the development of complex Systems describe innovation processes and the need for technology Management explain the aircraft development process and the process of type certification for aircraft explain the system development process, including requirements for systems reliability identify environmental conditions and test procedures for airborne Equipment value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (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: • understand their responsibilities within a development team and integrate themselves with their role in the overall process			with their role
Autonomy	Students are able to: • interact and communicate in a development tea	m which has distributed ta	sks	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: C International Management and Engineering: Speci International Management and Engineering: Speci Elective Compulsory Mechatronics: Specialisation System Design: Elect Mechatronics: Specialisation Intelligent Systems a Product Development, Materials and Production: S Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Technical Cor Theoretical Mechanical Engineering: Specialisation	compulsory alisation II. Aviation Syster cialisation II. Product Dev ive Compulsory nd Robotics: Elective Comp pecialisation Product Deve pecialisation Production: E pecialisation Materials: Ele nplementary Course: Elect A kircraft Systems Enginee	ns: Elective (velopment an oulsory elopment: Co lective Compu- cive Compuls ring: Elective	Compulsory nd Production: mpulsory pulsory ilsory ory e Compulsory

Course L1547: Systems	s Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: Innovation processes IP-protection Technology management Systems engineering Aircraft program Certification issues Systems development Safety objectives and fault tolerance Environmental and operating conditions Tools for systems engineering Requirements-based engineering (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: T	urbomachinery		
Courses			
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	Hrs/wk CP 3 4 1 2
Module Responsible	Prof. Franz Joos		
Admission Requirements	None		
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics,	Heat Transfer	
Educational Objectives	After taking part successfully, students have read	ched the following learning	results
Professional Competence	The students can distinguish the physical phenomena of corr 	oversion of energy	
Knowledge	understand the different mathematic mod calculate and evaluate turbomachinery. The students are able to	elling of turbomachinery,	
Skills	 - understand the physics of Turbomachinery, - solve excersises self-consistent. 		
Personal Competence			
Social Competence	discuss in small groups and develop an ap	proach.	
Autonomy	 The students are able to develop a complex problem self-consisten analyse the results in a critical way, have an qualified exchange with other stu 	t, dents.	
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56	
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale	90 min		
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineeri Energy Systems: Specialisation Energy Systems: Product Development, Materials and Produc Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical Co Theoretical Mechanical Engineering: Specialisation	ng: Elective Compulsory Elective Compulsory tion: Specialisation Produ Specialisation Production: E Specialisation Materials: Ele omplementary Course: Elec on Energy Systems: Elective	ict Development: Elective Elective Compulsory ective Compulsory tive Compulsory e Compulsory
Course L1562: Turbom	achines		
Тур	Lecture		

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: 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
СР	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: P	henomena and Methods in Ma	aterials Science		
Courses				
Title Experimental Methods for tl Phase equilibria and transfo	ne Characterization of Materials (L1580) rmations (L1579)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. V	Basic knowledge in Materials Science, e.g. Werkstoffwissenschaft I/ll		
Educational Objectives	After taking part successfully, students have	e reached the following	learning results	
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence				
Social Competence	The students are able to present solutions to	o specialists and to deve	elop ideas further.	
Autonomy	The students are able to • assess their own strengths and weak • gather new necessary expertise by th	nesses. neir own.		
Workload in Hours	I Independent Study Time 124. Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	International Management and Engineering Elective Compulsory Materials Science: Core qualification: Compu Product Development, Materials and Pr Compulsory Product Development, Materials and Produc Product Development, Materials and Produc Theoretical Mechanical Engineering: Techni Theoretical Mechanical Engineering: Special	g: Specialisation II. Pro oduction: Specialisatio tion: Specialisation Proc tion: Specialisation Mat cal Complementary Cou lisation Materials Scienc	duct Development a n Product Develop luction: Elective Com erials: Compulsory rse: Elective Compulso e: Elective Compulso	and Production: ment: Elective ipulsory sory iry

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 e	quilibria and transformations
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Proc	duction Systems (L0927)	Project-/problem-based	2	3
Emotional Design / User Ce	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	ce (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	ith Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	al Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and I	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)	-	Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)	Lecture	2	4
		Project-/problem-based	-	-
Productivity Management (I	L0928)	Learning	2	2
Productivity Management (I	L0931)	Recitation Section (small)	1	1
Feedback Control in Medica	I Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	5,	Lecture	2	2
Renewable Energy (11434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L037	79)		2	3
Materials Testing (L0940)	5)	Locture	2	2
Reliability in Engineering D	unamics (10176)	Lecture	2	2
Reliability in Engineering D	unamics (L1202)	Recitation Section (small)	2	2
Reliability of Aircraft System	ynannes (L1303)	Lecture	1	2
Medule Responsible		Lecture	Z	5
Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have read	hed the following learning	results	
Professional	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution strategies and new scientific methods in selected areas Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches 			
Personal Competence				
Social Competence	-			
Social competence				
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
·	Product Development, Materials and Product	ion: Specialisation Produ	ict Developn	nent: Elective
Assignment for the	Compulsory			2.000.70
Following Curricula	Product Development, Materials and Production:	Specialisation Production: E	Elective Comp	oulsory
	Product Development, Materials and Production:	Specialisation Materials: Ele	ective Compu	lsory

Course L1592: Applied	Automation
Тур	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

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

П

Course L0927: Element	s of Integrated Production Systems
Тур	Project-/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
	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.
Literature	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	

avT	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 L0310: Fatigue & Damage Tolerance	
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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 L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
Content	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
	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage
Literature	 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. Horshevich, C.T., Mechanics of fibrous composites", John Wiley, and Sons, Jac. New York.
	 Herakovich, C.I., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition. Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1258: Lightwe	ight Design Practical Course
Тур	Project-/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: Mechani	Course L0950: Mechanisms, Systems 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 sícher beurteilen und richtig einsetzen, Vieweg 	

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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 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 erogine 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
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: Microsys	Course L0724: Microsystems Technology	
Тур	Lecture	
Hrs/wk	2	
CP	4	
Workload in Hours	Independent Study Time 92. Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration	30 min	
	Draf Hac Khiam Triau	
Lecturer		
Language		
Cycle	Wi5e	
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, rop 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: 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, 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: clark electrode, enzyme electrode, DNA chip) Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptiv	
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	Project-/problem-based Learning
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. 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

ourse 1.0921 · Dreductivity Management	
Tum	
iyp	
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
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus
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

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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: Renewa	ble 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 L1513: Technical Design			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Schriftliche Ausarbeitung 10.15 Entwurfszeichnungen Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen, und		
and scale	Entwurfsbegründung)		
Lecturer	Prof. Werner Granzeier		
Language	DE		
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 		
	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		

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laction	
	AIRWORLD
	Design und Architektur für die Flugreise
	Vitra Design Stiftung Weil am Rhein 2004
	Airline Design
	Perter Deslius Jacek Slaski te Neues 2005
	Technik und Sicherheit von Passagierflugzeugen
	Frank Littek
	Motorbuch Verlag 2003
Literature	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		
СР	3		
Workload in Hours	Independent Study Time 62, St	udy 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 (solid state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.		
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
Content		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 C	Ceramics", John Wiley & Sons, New York, 1975	
	ASM Engineering Materials Han	dbook Vol.4 "Ceramics and Glasses", 1991	
Literature	D.W. Richerson, "Modern Ceran	nic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Materials	s 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 Mochanical Robaviour of Br	ittle Materials (L1661)	Typ	Hrs/wk	CP 3
Dislocation Theory of Plastic	city (L1662)	Lecture	2	3
Module Responsible	Dr. Erica Lilleodden			
Admission Requirements	None			
Recommended Previous Knowledge	Basics in Materials Science I/II			
Educational Objectives	After taking part successfully, students ha	ve reached the following lea	arning results	
Professional				
Competence				
Knowledge	Students can explain basic principles of thermodynamics (energy minimization, en	crystallography, statics (fr ergy barriers, entropy)	ee body diagrams,	tractions) and
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Personal Competence				
Social Competence	Students can provide appropriate feed constructively.	dback and handle feedb	ack on their ow	n performance
	Students are able to			
	- assess their own strengths and weakness	ses		
Autonomy	 assess their own state of learning in sp guided by teachers. 	pecific terms and to define	e further work step	s on this basis
	 work independently based on lecture clarifications when needed 	is and notes to solve pro	oblems, and to a	sk for help or
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the	Materials Science: Core qualification: Com Mechanical Engineering and Management: Product Development, Materials and I Compulsory	pulsory Specialisation Materials: El Production: Specialisation	lective Compulsory Product Develop	ment: Elective
Following Curricula	Product Development, Materials and Produ Product Development, Materials and Produ Theoretical Mechanical Engineering: Speci Theoretical Mechanical Engineering: Techr	uction: Specialisation Produc uction: Specialisation Materi alisation Materials Science: nical Complementary Cours	ction: Elective Com als: Compulsory Elective Compulso e: Elective Compuls	pulsory ry sory

Course L1661: Mechanical Behaviour 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		
	Theoretical Strength Of a perfect crystalline material, theoretical critical shear stress Real strength of brittle materials Exercise reactor 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		
Content	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		
	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		
Literature	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	
СР	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: C	ptimal and Robust Control			
Title		Two	Hrc/wk	CP
Optimal and Robust Control	(L0658)	Lecture	нгs/wк 2	3
Optimal and Robust Control	(L0659)	Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	 Classical control (frequency response, roo State space methods Linear algebra, singular value decomposit 	t locus) ion		
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	 Students can explain the significance or problems. They can explain the duality between option they can explain how the H2 and H2 performance constraints. They can explain how an LQG design problem. They can explain how model uncertainty controller design They can explain how - based on the sm stability and performance for an uncertair They understand how analysis and synthe linear matrix inequalities. 	f the matrix Riccati equat mal state feedback and opt infinity norms are used to lem can be formulated as s can be represented in a wa nall gain theorem - a robus plant. sis conditions on feedback l	ion for the imal state e: to represen pecial case y that lends st controller oops can be	solution of LQ stimation. It stability and of an H2 design is itself to robust can guarantee represented as
Skills	 Students are capable of designing and tur They are capable of representing a H2 or plant, and of using standard software tool They are capable of translating time and constraints on closed-loop sensitivity func They are capable of constructing an LF designing a mixed-objective robust contro They are capable of formulating analysis (LMI), and of using standard LMI-solvers for They can carry out all of the above using standard the solve usi	ing LQG controllers for mult H-infinity design problem in s for solving it. frequency domain specifica- tions, and of carrying out a Γ uncertainty model for an ller. and synthesis conditions a or solving them. standard software tools (Mai	civariable pla n the form of ations for co mixed-sensi uncertain ns linear ma tlab robust of	ant models. of a generalized ontrol loops into tivity design. system, and of trix inequalities control toolbox).
Personal Competence				
Social Competence Autonomy	Students can work in small groups on specific pr Students are able to find required information i documentation) and use it to solve given probler	oblems to arrive at joint solu n sources provided (lecture ns.	utions. e notes, liter	rature, software
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence En Electrical Engineering: Specialisation Control and Energy Systems: Core qualification: Elective Con Aircraft Systems Engineering: Specialisation Airc Computational Science and Engineering: Speci Compulsory Mechatronics: Specialisation Intelligent Systems Mechatronics: Specialisation System Design: Ele- Biomedical Engineering: Specialisation Artifi Compulsory Biomedical Engineering: Specialisation Implants Biomedical Engineering: Specialisation Managem Product Development, Materials and Product Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C	gineering: Elective Compuls I Power Systems: Elective Compulsory raft Systems: Elective Comp alisation Systems Engineer and Robotics: Elective Compulsory cial Organs and Regene and Endoprostheses: Elective echnology and Control Thee echnology and Control Theo ent and Business Administr tion: Specialisation Production: E Specialisation Materials: Election Control Production: Election Specialisation Materials: Election Control Production: roduction: Election Control Production Production Control Production Production Control Production Production Control Production Production Control	ory ompulsory nulsory ring and Ro pulsory rative Mecory: Elective ation: Elective ct Develop Elective Computive Computive computive Computive	botics: Elective licine: Elective ory Compulsory ve Compulsory ment: Elective upulsory ulsory sory

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

Module M1343: F	ibre-polymer-composites			
Courses				
Title Structure and properties of Design with fibre-polymer-c	fibre-polymer-composites (L1894) omposites (L1893)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous Knowledge	Basics: chemistry / physics / materials s	cience		
Educational Objectives	After taking part successfully, students	have reached the following le	arning results	
Professional Competence				
	/ matrix) and define the necessary testir	er-reinforced composites (FRP ng and analysis.) and its constituen	ts to play (fibei
Knowledge	They can explain the complex relationsh	nips structure-property relation	onship and	
	the interactions of chemical structure of including to explain neighboring context	of the polymers, their proces ts (e.g. sustainability, environ	sing with the differ mental protection).	ent fiber types
	Students are capable of			
Skills	 using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. approximate sizing using the network theory of the structural elements implement and evaluate. selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance. 			
Personal Competence				
	Students can			
Social Competence	 arrive at funded work results in h provide appropriate feedback and 	eterogenius groups and docu d handle feedback on their ov	ment them. vn performance cor	structively.
	Students are able to			
	- assess their own strengths and weakne	esses.		
	- assess their own state of learning in specific terms and to define further work steps on this basis			
Autonomy	assess their own state of rearming in specific terms and to define further work steps on this basis.			
	- assess possible consequences of their	professional activity.		
Washland in Ur	Independent Study Time 124, Charles Time	a in Lastura EC		
Crodit points	6			
Course achievement	v None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elec Aircraft Systems Engineering: Specialisa Aircraft Systems Engineering: Specialisa International Management and Engine Elective Compulsory Materials Science: Specialisation Engine Mechanical Engineering and Manageme Product Development, Materials and Pro Product Development, Materials and Pro Renewable Energies: Specialisation Biog Renewable Energies: Specialisation Sola Theoretical Mechanical Engineering: Spe Depretive Mechanical Engineering: Theoretical Mechanical Enginteering: Theoretic	tive Compulsory tion Cabin Systems: Elective ation Air Transportation Syste ering: Specialisation II. Prod ering Materials: Elective Com nt: Core qualification: Compu Production: Specialisation duction: Specialisation Mater energy Systems: Elective Cor d Energy Systems: Elective Cor constant Systems: Elective Cor cialisation Materials Science chalisation Materials Science	Compulsory ms: Elective Compu- uct Development a pulsory lsory Product Develop intion: Elective Com- pulsory ompulsory ompulsory : Elective Compulsor	ulsory and Production ment: Elective pulsory

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

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

Courses				
Title Processing of fibre-polymer-	-composites (L1895)	Typ Lecture	Hrs/wk 2	СР 3
From Molecule to Composite	es Part (L1516)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge in the basics of chemistry / p	physics / materials science		
Educational Objectives	After taking part successfully, students	have reached the following learni	ng results	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes 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.			
	Students can use the knowledge of matrix) and define the necessary testing	fiber-reinforced composites (FRP g and analysis.	and its cons	tituents (fiber /
Skills	They can explain the complex structure	-property relationship and		
	the interactions of chemical structure of including to explain neighboring context	of the polymers, their processing ts (e.g. sustainability, environmer	with the differ tal protection)	rent fiber types
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of 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			
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory			

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

Course L1516: From Mo	plecule to Composites Part
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	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 Manual M.Sc. "Product Development, Materials and Production" $\ensuremath{\mathsf{N}}$

Module M0563: R	obotics			
Courses				
Title Robotics: Modelling and Cor Robotics: Modelling and Cor	ntrol (L0168) ntrol (L1305)	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 3 3
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence	Students are able to describe fundamental pro	operties of robots and soluti	on approacl	hes for multiple
Knowledge	problems in robotics. Students are able to derive and solve equations of motion for various manipulators.			
Skills	Students can generate trajectories in various coordinate systems. Students can design linear and partially nonlinear controllers for robotic manipulators.			
Personal Competence Social Competence Autonomy	Students are able to work goal-oriented in small Students are able to recognize and improve kno With instructor assistance, students are able to course of study.	l mixed groups. wledge deficits independent evaluate their own knowled <u>c</u>	ly. je level and	define a further
Workload in Hours	Independent Study Time 110, Study Time in Leo	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechanical Engineering and Management: Core qualification: Compulsory Mechatronics: Core qualification: 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

Course L0168: Robotics	s: 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 Manual M.Sc. "Product Development, Materials and Production"

Module M0771: F	light Physics			
Courses				
Title Aerodynamics and Flight Me Flight Mechanics II (L0730) Flight Mechanics II (L0731)	chanics I (L0727)	Typ Lecture Lecture Recitation Section (large)	Hrs/wk 3 2 1	CP 3 2 1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation			
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Workload in Hours	Independent Study Time 96. Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: Co International Management and Engineering: Specia Product Development, Materials and Productio Compulsory Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Com	ompulsory lisation II. Aviation System n: Specialisation Produ pecialisation Production: E ecialisation Materials: Ele Aircraft Systems Enginee plementary Course: Elect	ms: Elective oct Develop Elective Comp ctive Comp ring: Elective tive Compuls	Compulsory ment: Elective pulsory ulsory e Compulsory sory

Course L0727: Aerodyn	amics and Flight Mechanics I
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
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 M	echanics II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke, Mike Montel
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. Frank Thielecke, Mike Montel	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0815: P	Product Planning			
Courses				
Title		Тур	Hrs/wk	СР
Product Planning (L0851)		Project-/problem-based Learning	3	3
Product Planning Seminar (I	L0853)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt			
Admission Requirements	None			
Recommended Previous Knowledge	Good basic-knowledge of Business Administration			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
-	Students will gain insights into:			
Knowledge	 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 instrume 	ents		
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 Lectu	re 70		
Credit points	6			
Course achievement	CompulsorBonus Form Yes 20 % Subject theoretical an practical work	Description nd		
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	Global Innovation Management: Core qualification Global Technology and Innovation Management & International Management and Engineering: Compulsory Mechanical Engineering and Management: Special Product Development, Materials and Productio Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Specialisat Compulsory	: Compulsory Entrepreneurship: Core q Specialisation I. Electiv isation Management: Elec on: Specialisation Produ pecialisation Production: pecialisation Materials: El ion Product Developmer mplementary Course: Elec	ualification: (ves Manage ctive Compul: uct Develop Elective Comp nt and Produ ctive Compul:	Compulsory ment: Elective sory ment: Elective pulsory ulsory uction: Elective sory

Course L0851: Product	Planning
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	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 Voluntary presentations in the third hour (articles / case studies) - Guest lectures by researchers - Lecture on Sustainability with frequent reference to current research - Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

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

Module M0830: E	nvironmental Protection and M	anagement		
Courses				
Title Integrated Pollution Control Health, Safety and Environr Health, Safety and Environr	(L0502) nental Management (L0387) nental Management (L0388)	Typ Lecture Lecture Recitation Section (small)	Hrs/wk 2 2 1	CP 2 3 1
Modulo Bosponsiblo	Brof Balf Ottorpabl			
Admission				
Requirements	None			
Recommended Previous Knowledge	 Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) Good knowledge of the relevant Environmental Legislation Basic knowledge of instruments for Environmental Assessment 			
Educational Objectives	After taking part successfully, students have i	reached the following learning	results	
Professional Competence				
Knowledge	The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.			
Skills	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.			
Personal Competence Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to the discussions. They can acquire appropri-	to prepare themselves for pres ate knowledge by making enqu	entations an iiries indepe	nd contributions ndently.
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core qualification: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: 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 Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L0502: Integrat	ed 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
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 Environmental Management
Тур	Lecture
Hrs/wk	2
СР	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

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: S	ustainability and Risk Ma	anagement		
Courses				
Title Safety, Reliability and Risk <i>A</i> Environment and Sustainab	Assessment (L1145) ility (L0319)	Typ Seminar Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stude	nts have reached the following lea	arning results	
Professional Competence				
Knowledge	 basics are able to describe single assessment as well as environmenta basics in safety and reliability safety and reliability analysis risk assessment Production and usage of bio-c energy production and supply sustainable product design 	al and sustainable engineering, in of technical facilities methods thar	detail:	salety and fisk
Skills	Students are able apply interdi sustainability reporting. They can e feasible treatment concepts.	sciplinary system-oriented met valuate the effort and costs for p	hods for risk as processes and sele	ssessment and ct economically
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the Furthermore, they can define targ management and sustainability cor impact.	subject area from given sources gets for new application or reso neepts accordance with the poter	and transform it to earch-oriented dui itial social, econor	new questions. ties in for risk nic and cultural
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 mi	nutes in groups)		
Assignment for the Following Curricula	Civil Engineering: Core qualification: International Management and Engin Product Development, Materials Compulsory Product Development, Materials and Product Development, Materials and Water and Environmental Engineerin	Compulsory neering: Specialisation II. Civil Eng and Production: Specialisation I Production: Specialisation Produc I Production: Specialisation Materi ng: Core qualification: Compulsory	jineering: Elective Product Develop ction: Elective Com als: Elective Comp	Compulsory ment: Elective upulsory ulsory

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: Environr	nent and Sustainability
Тур	Lecture
Hrs/wk	2
СР	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, waster 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
Literature	wird in der veranstaltung bekannt gegeben.

Module M1024: M	Nethods of Integrated Produc	t Development		
Courses				
Title Integrated Product Develop	ment II (L1254)	Typ Lecture	Hrs/wk 3	CP 3
Integrated Product Develop	ment II (L1255)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of Integrated product dev	elopment and applying CAE syste	ems	
Educational Objectives	After taking part successfully, students hav	ve 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 of integrated product development. 			
Skills	 After passing the module students are able to: select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions, solve product development problems with the assistance of a workshop based approach, choose and execute appropriate moderation techniques. 			
Personal Competence Social Competence	After passing the module students are able • prepare and lead team meetings an • work in teams on complex tasks, • represent problems and solutions ar	e to: d moderation processes, nd advance ideas.		
Autonomy	After passing the module students are able • give a structured feedback and acce • implement the accepted feedback a	e to: ept a critical feedback, utonomous.		
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
Course achievement	None			
Examination Examination duration and scale	30 Minuten			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

Course L1254: Integrat	ed Product 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
	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
Content	 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. 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 Development II	
Тур	Project-/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 M1155: A	ircraft Cabin Systems			
Courses				
Title Aircraft Cabin Systems (L15 Aircraft Cabin Systems (L15	45) 46)	Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems			
Educational Objectives	After taking part successfully, students have react	hed the following learning	results	
Professional Competence				
Knowledge	Students are able to: • describe cabin operations, equipment in the cab • explain the functional and non-functional require • elucidate the necessity of cabin operating system • assess the challenges human factors integration	in and cabin Systems ements for cabin Systems ms and emergency System i in a cabin environment	าร	
Skills	Students are able to: • design a cabin layout for a given business mode • design cabin systems for safe operations • design emergency systems for safe man-machir • solve comfort needs and entertainment requirer	l of an Airline ne interaction ments in the cabin		
Personal Competence				
Social Competence	Students are able to: • understand existing system solutions and discus	ss their ideas with experts		
Autonomy	Students are able to: • Reflect the contents of lectures and expert prese	entations self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
and scale	120 Minutes			
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Energy Systems: Specialisation Energy Systems: E Aircraft Systems Engineering: Core qualification: C International Management and Engineering: Speci Product Development, Materials and Producti Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Con	Power Systems Engineerin Elective Compulsory Jalisation II. Aviation System on: Specialisation Production: E Specialisation Production: Elect on Aircraft Systems Enginee mplementary Course: Elect	g: Elective C ms: Elective lect Develop Elective Comp ring: Electiv tive Compuli	compulsory Compulsory ment: Elective pulsory ulsory e Compulsory sory

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
	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.
Content	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 M1025: F	luidics				
Courses					
Title Fluidics (L1256) Fluidics (L1371)			Typ Lecture Project-/problem-based	Hrs/wk 2 1	CP 3 2
Fluidics (L1257)			Learning Recitation Section (large)	1	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge	Good knowledge of me mechanics, and engine	chanics (stereo statics ering design	, elastostatics, hydrostatics, k	inematics an	d kinetics), fluid
Educational Objectives	After taking part succe	ssfully, students have	reached the following learning	results	
Professional Competence					
	After passing the modu	ile students are able to)		
Knowledge	 explain structures and functionalities of hydrostatic, pneumatic, and hydrodynamic components, explain the interaction of hydraulic components in hydraulic systems, explain open and closed loop control of hydraulic systems, describe functioning and applications of hydrodynamic torque converters, brakes and clutches as well as centrifugal pumps and aggregates in plant technology 				
Skills	After passing the modu analyse and ass design and dime perform numeri select and adap dimension hydro	ile students are able to ess hydraulic and pnet ension hydraulic systen cal simulations of hydr. c pump characteristic o dynamic torque conve	o imatic components and syster ns for mechanical applications aulic systems based on abstra urves for hydraulic systems rters and brakes for mechanic	ns, , ct problem d al aggregate	efinitions, ıs.
Personal Competence					
Social Competence	After passing the modu discuss and pres organise teamw	 discuss and present functional context in groups, organise teamwork autonomously. 			
Autonomy	After passing the modu	ile students are able to y knowledge for the sir) nulation.		
Workload in Hours	Independent Study Tim	ne 124, Study Time in I	_ecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes None	Form Attestation	Description Simulation hydrostatis	cher Systeme	2
Examination	Written exam				
Examination duration and scale	90				
Assignment for the Following Curricula	International Managem International Manager Elective Compulsory Product Development, Product Development, Theoretical Mechanica Compulsory Theoretical Mechanica	ent and Engineering: 5 nent and Engineering: Materials and Producti Materials and Producti Materials and Producti I Engineering: Specia Engineering: Technica	Specialisation II. Mechatronics: Specialisation II. Product Dev on: Specialisation Product Dev on: Specialisation Production: on: Specialisation Materials: Ei ilisation Product Developmer al Complementary Course: Elec	Elective Corr evelopment: Corr Elective Comp ective Comp at and Prod	npulsory and Production: ompulsory upulsory uction: Elective sory

Course L1256: Fluidics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Cycle	UPE WiSe Lecture Hydrostatics • hydraulic fluids • hydrostatic machines • valves • components • hydrostatic transmissions • examples from industry Pneumatics • generation of compressed air • pneumatic motors • Examples of use Hydrodynamics • hydrodynamics • hydrodynamic transmissions • interoperation of motor and transmission Exercise Hydrodynamics • leading and design of hydraulic diagrams • dimensioning of hydrostatic traction and working drives • performance calculation Hydrodynamics • calculation / dimensioning of hydroynamic torque converters • calculation / dimensioning of centrifugal pumps • creating and reading of characteristic curves of pumps and systems Field trip • field trip to a regional company from the hydraulic industry. Exercise Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model<
	 simulation of common components variation of simulation parameters using simulations for system dimensioning and optimisation (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

Typ Project-/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	Course L1371: Fluidics	
Hrs/wk 1 CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause Language DE	Тур	Project-/problem-based Learning
CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause Language DE	Hrs/wk	1
Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause Language DE	CF	2
Lecturer Prof. Dieter Krause Language DE	Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Language DE	Lecture	Prof. Dieter Krause
	Language	DE
Cycle WiSe	Cycle	WiSe
Content See interlocking course	Content	See interlocking course
Literature See interlocking course	Literature	See interlocking course

Course L1257: Fluidics				
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	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 M1342: P	olymers			
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Courses				
Title Structure and Properties of Processing and design with	Polymers (L0389) polymers (L1892)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous Knowledge	Basics: chemistry / physics / material sciene	ce		
Educational Objectives	After taking part successfully, students hav	e reached the following l	earning results	
Professional				
competence	Students can use the knowledge of plastics	and define the necessar	y testing and analysi	is.
	They can explain the complex relationships	structure-property relati	onshin and	
Knowledge	the interactions of chemical structure of the sustainability, environmental protection).	ne polymers, including to	explain neighboring	g contexts (e.g.
	Students are capable of			
Skills	 using standardized calculation methods strength) to calculate and evaluate the difference 	s in a given context to erent materials.	mechanical prope	rties (modulus,
	 selecting appropriate solutions for me corrosion resistance. 	chanical recycling probl	ems and sizing exa	ample stiffness,
Personal Competence				
	Students can			
	- arrive at funded work results in heterogen	ius groups and documen	t them.	
Social Competence	 provide appropriate feedback and handle 	feedback on their own pe	erformance construc	tively.
	Students are able to			
	- assess their own strengths and weakness	20		
Autonomy	assess then own sectory in a conjunt weaking set.			
	 - assess their own state of learning in specific terms and to define further work steps on this basis. 			
	 assess possible consequences of their pro 	fessional activity.		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
and scale	180 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineerin Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Man Biomedical Engineering: Specialisation Med Product Development, Materials and Produc Product Development, Materials and Produc Product Development, Materials and P Compulsory Theoretical Mechanical Engineering: Techni Theoretical Mechanical Engineering: Special	ng Materials: Elective Cor lants and Endoprosthese: Artificial Organs and agement and Business A ical Technology and Com- ction: Specialisation Prod tition: Specialisation Mate roduction: Specialisatior cal Complementary Cour lisation Materials Science	npulsory s: Compulsory Regenerative Med dministration: Elective trol Theory: Elective uction: Elective Comp rials: Elective Compulso se: Elective Compulso	icine: Elective ve Compulsory Compulsory pulsory ulsory ment: Elective sory

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

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

Module M1185: Specific Regulation	Technical Complementary (ons)	Course for PEPMS	(according to	Subject
Courses				
Title		Тур	Hrs/wk	СР
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	See selected module according to FSPO			
Educational Objectives	After taking part successfully, students h	ave reached the following le	arning 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	Depends on choice of courses			
Credit points	6			
Assignment for the Following Curricula	Product Development, Materials and Compulsory Product Development, Materials and Proc Product Development, Materials and Proc	Production: Specialisation duction: Specialisation Produ duction: Specialisation Mater	Product Developme Iction: Elective Compu rials: Elective Compuls	ent: Elective Isory ory

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: A	ircraft Systems I
Courses	
Title Aircraft Systems I (L0735) Aircraft Systems I (L0739)	TypHrs/wkCPLecture34Recitation Section (large)22
Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: Mathematics Mechanics Thermodynamics Electrical Engineering Hydraulics Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional	
Knowledge	 Students are able to: Describe essential components and design points of hydraulic, electrical and high-lift systems Give an overview of the functionality of air conditioning systems Explain the need for high-lift systems such as ist functionality and effects Assess the challenge during the design of supply systems of an aircraft
Skills	 Students are able to: Design hydraulic and electric supply systems of aircrafts Design high-lift systems of aircrafts Analyze the thermodynamic behaviour of air conditioning systems
Personal Competence	
Social Competence	Students are able to:Perform system design in groups and present and discuss results
Autonomy	Students are able to: • Reflect the contents of lectures autonomously
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination Examination duration and scale	Written exam 165 Minutes
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Elective Compulsory 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

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 hydrauli systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and hea balances; emergency power) Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrica power distribution; bus systems; monitoring; load analysis) High Lift Systems (Principles; investigation of loads and system actuation power; principles an 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)
Literature	 Moir, Seabridge: Aircraft Systems Green: Aircraft Hydraulic Systems Torenbek: Synthesis of Subsonic Airplane Design SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

ourse 1 0739: Aircraft Systems I	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Proc	duction Systems (L0927)	Project-/problem-based	2	3
Emotional Design / User Cer	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	ce (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	ith Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	l Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and I	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (I	L0928)	Project-/problem-based	2	2
Dreductivity Menegeneent (I	0021)	Learning	1	1
Productivity Management (I	LU931)	Recitation Section (small)	1	1
Peedback Control In Medica	rechnology (L0664)	Lecture	2	3
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Signa (L1130)		Lecture	2	3
Coromical Design (L1513)		Lecture	2	3
Meteriale Testing (LOS/	9)	Lecture	2	3
Materials Testing (L0949)	(nomine (10176)	Lecture	2	2
Reliability in Engineering Dy		Lecture	2	2
Reliability in Engineering Dy		Recitation Section (small)	1	2
		Lecture	Z	3
Module Responsible	Prof. Dieter Krause			
Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution strategies and new scientific methods in selected areas Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches 			
Personal Competence				
Social Competence	-			
Social competence				
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	12			
	Product Development, Materials and Product	ion: Specialisation Produ	ct Developn	nent: Elective
Assignment for the	Compulsory			
Following Curricula	Product Development, Materials and Production: S	Specialisation Production: E	elective Comp	oulsory
_	Product Development, Materials and Production: S	Specialisation Materials: Ele	ective Compu	lsory

Course L1592: Applied	Automation
Тур	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

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

П

Course L0927: Elements of Integrated Production Systems		
Тур	Project-/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	
	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.	
Literature	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: Emotion	al 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

Түр	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 If 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 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 L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightwe	ight Construction with Fibre Reinforced Rolymers - Structural Mechanics
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
_	Strength of Laminated Plates
Content	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
	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. Wiedemann L., Leichtbau Band 1: Elemente" Springer, Berlin, Heidelberg, aktuelle Auflage
Literature	 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.

Course L1258: Lightweight Design Practical Course	
Тур	Project-/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. 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
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 sícher beurteilen und richtig einsetzen, Vieweg

Module Manual M.Sc. "Product Development, Materials and Production" $\ensuremath{\mathsf{N}}$

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 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 erogine 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
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: Microsys	stems Technology
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cvcle	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 undercuting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RLE, Bosch process, Crop process, XE2 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 (glavanomagnetic sensors: spinning current Hall sensor and magneto-transistor: magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetomagnetic Sensors (glavanomagnetic sensors, Clark electroke, enzyme electrode, DNA chip) Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, nardar group robal electrona, microvalues: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microBipenser, microfluidic switching elements, microreactor, lab-on-a-chip, micro
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	Project-/problem-based Learning
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. 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 10021, Productivity Management	
Tum	
iyp	
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	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus
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: Renewa	ble Energy
Typ 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 L1513: Technical Design		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	10-15 Entwurfszeichnungen Skizzen und ca 5-10 A4-Dokumentationsseiten (Themen- und	
and scale	Entwurfsbegründung)	
Lecturer	Prof. Werner Granzeier	
Language	DE	
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 	
	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	

laction	
	AIRWORLD
	Design und Architektur für die Flugreise
	Vitra Design Stiftung Weil am Rhein 2004
	Airline Design
	Perter Deslius Jacek Slaski te Neues 2005
	Technik und Sicherheit von Passagierflugzeugen
	Frank Littek
	Motorbuch Verlag 2003
Literature	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: Ceramic	s Technology		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, St	udy 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 (solid state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.		
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
Content		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 Han	dbook Vol.4 "Ceramics and Glasses", 1991	
Literature	D.W. Richerson, "Modern Ceran	nic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Materials Testing			
Typ	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 M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1592))	Project-/problem-based	3	3
Ergonomics (L0653)		Lecture	2	3
Elements of Integrated Prod	luction Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Cer	ntered Product Development (L1703)	Seminar	2	2
Development Management	for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerand	te (L0310)	Lecture	2	3
Industry 4.0 for engineers (I	L2012)	Lecture	2	3
Lightweight Construction wi (L1514)	th Fibre Reinforced Rolymers - Structural Mechanics	Lecture	2	3
Lightweight Design Practica	l Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and F	Processes of Materials Testing (L0950)	Lecture	2	2
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (I	_0724)	Lecture	2	4
Productivity Management (L	.0928)	Project-/problem-based Learning	2	2
Productivity Management (L	.0931)	Recitation Section (small)	1	1
Feedback Control in Medica	l 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
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L037	9)	Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dy	namics (L0176)	Lecture	2	2
Reliability in Engineering Dy	(namics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft System	ns (L0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended	None			
Educational Objectives	After taking part successfully, students have read	hed the following learning	roculto	
Professional	Arter taking part successfully, students have reac	ned the following learning	results	
Competence				
Knowledge	 Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production Students are qualified to connect different special fields with each other 			
Skills	 Students can apply specialized solution str. Students are able to transfer learned skills solution approaches 	ategies and new scientific r to new and unknown prob	methods in se plems and car	lected areas develop own
Personal Competence				
Social Competence	-			
Joelal competence				
Autonomy	Students are able to develop their knowled	ge and skills by autonomo	us election of	courses.
Workload in Hours	Depends on choice of courses			
Credit points	6			
	Product Development Materials and Product	ion: Specialisation Produ	ct Developm	ent: Elective
Assignment for the	e Compulsory			
Following Curricula	Product Development, Materials and Production: Specialisation Production: Elective Compulsory			
	Product Development, Materials and Production: S	Specialisation Materials: Ele	ective Compul	sory

Course L1592: Applied Automation		
Тур	Project-/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 Minuten	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy	
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992	

ourse 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	

П

Course L0927: Element	s of Integrated Production Systems
Тур	Project-/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
	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.
Literature	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: Emotion	al 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: Develop	ment Management for Mechatronics
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. 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 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 L2012: Industry	v 4.0 for engineers
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightwe	ight Construction with Fibre Reinforced Rolymers - Structural Mechanics
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 min
Lecturer	Prof. Benedikt Kriegesmann
Language	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 effects; Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
Content	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
	• Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle
Literature	 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.

Course L1258: Lightwe	ight Design Practical Course
Тур	Project-/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: Mechani	sms, Systems 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 sícher beurteilen und richtig einsetzen, Vieweg

Module Manual M.Sc. "Product Development, Materials and Production" $\ensuremath{\mathsf{N}}$

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 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 erogine 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
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"

Typ Hrs/wk CP Workload in Hours	Lecture 2 4 Independent Study Time 92, Study Time in Lecture 28
Hrs/wk CP Workload in Hours	2 4 Independent Study Time 92, Study Time in Lecture 28 Wündliche Brüfung
CP Workload in Hours	4 Independent Study Time 92, Study Time in Lecture 28
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Mündliche Prüfung
Examination Form	Multulicite Fruitulig
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) 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, Kr29 crocess, 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: thermo resistor, Pt-100, spreading resistance sensor; pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile; modulating sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensor, cancel curve, enzyme electrode, DNA chip) Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and electronsection, environe electroide, DNA chip) Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; ligh
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	Project-/problem-based Learning	
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. 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	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Prof. Herbert Werner, Johannes Kreuzer, Christian Neuhaus	
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		
Typ 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 L1513: Technical Design			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Schriftliche Ausarbeitung		
and scale	Entwurfsbegründung)		
Lecturer	Prof. Werner Granzeier		
Language	DE		
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 		
	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		
	NEW TOR 1905		

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	AIRWORLD	I
	Design und Architektur für die Flugreise	
	Vitra Design Stiftung Weil am Rhein 2004	
	Airline Design	
	Perter Deslius Jacek Slaski te Neues 2005	
	Technik und Sicherheit von Passagierflugzeugen	
	Frank Littek	
	Motorbuch Verlag 2003	
Literature	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	
		н

Course L0379: Ceramic	s Technology	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, St	udy 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
Content		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 C	Ceramics", John Wiley & Sons, New York, 1975
	ASM Engineering Materials Han	dbook Vol.4 "Ceramics and Glasses", 1991
Literature	D.W. Richerson, "Modern Ceran	nic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung	

Course L0949: Material	Is Testing
Түр	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	
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. 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 M1193: Cabin Systems Engineering					
Courses					
Title Computer and communicati Computer and communicati	on technology in cabin electronics and avionics (L1557) on technology in cabin electronics and avionics (L1558)	Typ Lecture Recitation Section (small)	Hrs/wk 2 1	CP 2 1	
Model-Based Systems Engir	eering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3	
Module Responsible	Prof. Ralf God				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering				
Educational Objectives	After taking part successfully, students have reach	ed the following learning i	results		
Professional					
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 network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network • model system functions by means of formal languages SysML/UML and generate software code from the models • execute software code on a minicomputer				
Personal Competence					
Social Competence	Students are able to: • elaborate partial results and merge with others to	o form a complete solutior	n		
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				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	120 minutes				
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: 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 Production: Elective Compulsory 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 Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory				

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 communication 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	Project-/problem-based Learning					
Hrs/wk	3					
СР	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 					
	lectricity Generation from W	ind and Hydro Powe	r			
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Courses						
Title Renewable Energy Projects Hydro Power Use (L0013) Wind Turbine Plants (L0011) Wind Energy Use - Focus Of	in Emerged Markets (L0014)) fshore (L0012)	Typ Project Seminar Lecture Lecture Lecture	Hrs/wk 1 1 2 1	CP 1 1 3 1		
Modulo Bosponsiblo	Dr. Joschim Gorth					
Admission						
Requirements	Module: Technical Thermodynamics I					
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Fundamentals of Fluid Mechanics					
Educational Objectives	After taking part successfully, students ha	we reached the following learn	ing results			
Professional Competence	By ending this module students can expla	in in detail knowledge of wind	turbines with a	particular focus		
Knowledge	of wind energy use in offshore conditions and can critical comment these aspects current developments. Furthermore, they are able to describe fundamentally the us generate electricity. The students reproduce and explain the basic procedure in the <i>Knowledge</i> renewable energy projects in countries outside Europe.			water power to plementation of		
	Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice.					
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applies approach in Europe and can apply this procedure on exemplary theoretical projects.					
Personal Competence						
Social Competence	Students can discuss scientific tasks subj	et-specificly and multidisciplin	ary within a sem	ninar.		
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture materi 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					
Course achievement	None					
Examination	Written exam					
Examination duration and scale	3 hours written exam					
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: 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 Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Energy Systems: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory					

Course L0014: Renewa	ble Energy 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	Prof. Andreas Wiese
Language	DE
Cycle	SoSe
Content	 Introduction Development of renewable energies worldwide History Future markets Special challenges in new markets - Overview

Literature Folien der Vorlesung

Course L0013: Hydro P	ower Use
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. 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 hydropectric 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 Tu	rbine Plants
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann
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 En	ergy Use - Focus Offshore
Тур	Lecture
Hrs/wk	1
СР	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 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

Module M0630: R	obotics and	d Navi	igation in	Medicin	e				
Courses									
Title Robotics and Navigation in Robotics and Navigation in Robotics and Navigation in	Medicine (L0335) Medicine (L0338) Medicine (L0336)				Typ Lecture Project Seminar Recitation Section (s	small)	Hrs/wk 2 2 1	CP 3 2 1	
Module Responsible	Prof. Alexander	Schlaefe	er						
Admission Requirements	None	lone							
Recommended Previous Knowledge	 principles principles solid R or 	s of matł s of prog r Matlab	n (algebra, ana ramming, e.g. skills	alysis/calculu , in Java or C	5) + +				
Educational Objectives	After taking par	t succes	sfully, student	s have reach	ed the following lea	irning re	esults		
Professional Competence									
Knowledge	The students ca and their comp safety and regu	an expla conents Ilations. S	in kinematics in detail. Sys Students can a	and tracking tems can be assess typica	systems in clinica evaluated with re systems regarding	I conte: espect t design	xts and ill o collision and limit	ustrate detect ations.	systems tion and
Skills	The students a applications.	are able	to design and	d evaluate n	avigation systems	and rot	ootic syste	ems for	medical
Personal Competence									
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work.								
Autonomy	The students ca results in an ap	an reflect propriate	t their knowled e manner.	dge and docu	ment the results of	f their w	ork. They	can pre	esent the
Workload in Hours	Independent Stu	udy Time	e 110, Study T	ime in Lectur	e 70				
Credit points	6								
Course achievement	Yes 10 Yes 10	nus % %	Form Written elabo Presentation	ration	Description				
Examination	Written exam								
Examination duration and scale	90 minutes								
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Productors: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory 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 Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory								

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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.

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

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			
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 M0996: S	upply Chain Ma	anagement				
Courses						
Title			Т	Гур	Hrs/wk	СР
Supply Chain Management	(L1218)		P	roject-/problem-based .earning	3	4
Value-Adding Networks (L11	190)		L	ecture	2	2
Module Responsible	Prof. Thorsten Blecker	r				
Admission Requirements	None					
Recommended	no					
Previous Knowledge				d bles following looguing		
Professional	After taking part succ	essiully, students	s nave reached	a the following learning	gresuits	
Competence						
Knowledge	internationalization ar Theoretical Approach to identify fields of c reasons for the fo (transaction cost theoretic Selected approache to illustrate phases to understand th relationships. to explain and cated to categorize sourci advantages and dis- the two terms . to state criteria/ fac (total network costs). to explain methods to interpret phenoty recognize relationsl models. to solve sub-probl- networks) by the use to categorise speci practical examples of	nd globalization a thes and methods decision in SCM . ormation of netw ory, principal-ager is to explain the d of network formati- te functional me gorize relationship ng concepts and d advantages of off ctors/ parameters for location findin vpes of productior hips between R & ems with the co of appropriate ap- ial waste logistics good networking	Ind emerging in s in logistics are vorks based on the theory, prop levelopment of tion. echanisms of ps within netwer explain motive fshoring and o s that influence ing/evaluation. In networks. A D and produce progration of pproaches. s including the proaches.	markets illustrated by nd supply chain manage on various theories f perty-right theory) and if networks. if inter-organizational rorks. es/ barriers or advanta utsourcing and to illus the production location inction and their location f logistics networks (a eir duties & objective	examples fro gement and u irom instituti the resource and interna ges and disa- trate the dist decisions at decisions at ons and to de distribution a s and to sta	m practice. se in practice. onal economic -based view. tional network dvantages. inction between the global leve scribe coheren and spare part: te and describe
Skills	 to asses trends and challenges in national and international supply chains and logistics networks and their consequences for companies. to evaluate, anaylse and systematise networks and network relations based on the lecture. to anaylse partners and their suitability for co-operation in collaborations and cooperative relations. to select sourcing concepts for specific products / product components based on the lecture as well as advantages and disadvantages of each approach. to evaluate location decisions for production and R & D based on concepts. to recognize relationships between R & D and production as well as their locations and to evaluate the suitability of specific models for different situations. to transfer the analyzed concepts to international practices. to analyse concepts of Information and communication management in logistics. to design subcontracting, procurement, production and disposal as well as R & D networks to shape, to plan reorganise efficient and flow-oriented enterprise networks. 					
Personal Competence						
Social Competence	 to evaluate intercult advance planning a in the lecture. definition of procura networks. design of the procurand core competencie to make decision of and buying/selling ma D. Decision on R & D I the selection of an ap 	tural and internat and design of net ement strategies urement network es, as well as on t f location for proc arkets, which were ocations based or propriate model.	tional relations twork formatic for individual (external/inter the findings of duction taking e also discusso n the insights	ships based on discuss on and their objectives parts using the gaine rnal/modules etc.) bas the case studies. y into account global c ed in the case studies gained from case stud	ed case studi based on co d knowledge ed on the so contexts, eval and their dep dies / practica	es. ntent discussed of procuremen urcing concept uation method endence on R & al examples and
Autonomy	After completing the Chain Management a	module students nd transfer the ac	s are capable cquired knowle	e to work independent edge to new problems.	tly on the su	bject of Supply
Workload in Hours	Independent Study Ti	me 110, Study Tir	me in Lecture	70		
Credit points	6 CompulsorParts	Eorm		Description		
Course achievement	No 15 %	Subject theo	pretical and	im Rahmen der Lehrv Management"	veranstaltung	"Supply Chair
Examination	Written exam	,		J		
Examination duration	120 min					
and scale						
Assignment for the Following Curricula	International Manag Compulsory Logistics, Infrastructu Product Developmer Compulsory Product Development	ement and Eng re and Mobility: S nt, Materials and r, Materials and Pr	gineering: Sp Specialisation I Id Production roduction: Spe	ecialisation I. Electi Production and Logistic : Specialisation Prod scialisation Production:	ves Manage cs: Elective C luct Develop Elective Con	ment: Elective ompulsory oment: Elective opulsory

Product Development, Materials and Production: Specialisation Materials: Elective Compulsory

Course L1218: Supply (Chain Management
Тур	Project-/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 of an 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	 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 Networks				
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	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 M0764: A	ircraft Systems II			
Courses				
Title Aircraft Systems II (L0736) Aircraft Systems II (L0740)		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	 Students are able to describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. explain different configurations and designs and their origins explain atmospheric conditions for icing such as the functionality 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				
	Students are able to:			
Social Competence	 Develop joint solutions in mixed teams 			
Autonomy	 Students are able to: derive requirements and perform approsystems from complex issues and circumstance 	priate yet simplified de ances in a self-reliant man	sign proces ner	ses for aircraft
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	Aircratt Systems Engineering: Core qualification: C International Management and Engineering: Speci Product Development, Materials and Producti Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Theoretical Mechanical Engineering: Technical Co Theoretical Mechanical Engineering: Specialisation	compulsory alisation II. Aviation Syster on: Specialisation Produ pecialisation Production: E pecialisation Materials: Ele nplementary Course: Elec Aircraft Systems Enginee	ms: Elective Ict Develop Elective Comp ective Compute tive Compute ering: Elective	Compulsory ment: Elective pulsory Jlsory sory e Compulsory

Course L0736: Aircraft	Systems II
Тур	Lecture
Hrs/wk	3
СР	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) De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
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	
СР	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: M	Aedical Imaging Systems		
Courses			
Title Medical Imaging Systems (L	Typ Hrs/wk L0819) Lecture 4	CP 6	
Module Responsible	Dr. Michael Grass		
Admission Requirements	None		
Recommended Previous Knowledge	none		
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 main clinical imaging Explain how the system components and the overall system of the imaging syst Explain and apply the physical processes that make imaging possible ar fundamental physical equations; Name and describe the physical effects required to generate image contrasts; Explain how spatial and temporal resolution can be influenced and how to images generated; Explain which image reconstruction methods are used to generate images; 	systems; ems function; nd use with the characterize the	
Skills	 Students are able to: Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required; 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	none		
	Students can:		
Autonomy	 Understand which physical effects are used in medical imaging; Decide independently for which clinical issue a measuring system can be used. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and scale			
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Biomedical Engineering: Core qualification: Compulsory Product Development, Materials and Production: Specialisation Product Develo Compulsory Product Development, Materials and Production: Specialisation Production: Elective Co Product Development, Materials and Production: Specialisation Materials: Elective Com Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compu Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective	opment: Elective mpulsory upulsory ulsory ve Compulsory	

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

Module M1143: M	lechanical Design Methodo	logy		
Courses				
Title Mechanical Design Methodo Mechanical Design Methodo	ology (L1523) ology (L1524)	Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	Science-based working on product design considering targeted application of specific product design techniques			
Skills	Creative handling of processes used for scientific preparation and formulation of complex product design problems / Application of various product design techniques following theoretical aspects.			
Personal Competence				
Social Competence				
Autonomy	1			
Workload in Hours	Independent Study Time 124, Study Tir	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	International Management and Engine Elective Compulsory Mechatronics: Specialisation System De Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Product Development, Materials and Pro Product Development, Materials and Pro Product Development, Materials and Pro Product Development, Materials and Pro Theoretical Mechanical Engineering: Theoretical	ering: Specialisation II. Product Development esign: Elective Compulsory on Artificial Organs and Regene Implants and Endoprostheses: Electiv Medical Technology and Control Theo Management and Business Administr d Production: Specialisation Production: E oduction: Specialisation Production: Election Specialisation Product Development choical Complementary Course: Election	relopment a rative Med re Compulso ry: Elective ation: Elective ation: Elective ct Develop lective Compu- ctive Compu- i and Produ	nd Production: icine: Elective ry Compulsory ve Compulsory ment: Elective pulsory ulsory uction: Elective

Course L1523: Mechani	ical Design 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	1	
СР	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 M1145: A	utomation and Simulation				
Courses					
Title		Тур	Hrs/wk	СР	
Automation and Simulation	(L1525)	Lecture	3	3	
Automation and Simulation	(LI527)	Recitation Section (large)	Z	3	
Module Responsible	NN				
Requirements	None				
Recommended Previous Knowledge	BSc Mechanical Engineering or sim	ilar			
Educational Objectives	After taking part successfully, students	have reached the following learning	results		
Professional Competence					
	Students can describe the structure components, the data transfer via bus	e an the function of process com systems an programmable logic comp	puters, the outers .	corresponding	
Knowladge	They can describe the basich principle	of a numeric simulation and the corre	sponding p	arameters.	
Knowledge	Thy can explain the usual method to si	mulate the dynamic behaviour of thre	e-phase ma	achines.	
	Students can describe and design simp	ole controllers using established metho	odes.		
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.				
Skills	Matlab/Simulink for the simulation.				
	They are able to applay established m phase machines.	ethods for the caclulation of the dyr	amical beh	aviour of three-	
Personal Competence					
Social Competence	Teamwork in small teams.				
Autonomy	Students are able to identify the need these analysisis in an adequate manne	of methocic analysises in the field of or und to evaluate the results critically	automatior	systems, to do	
Workload in Hours	Independent Study Time 110, Study Ti	me in Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa	1 Stunde			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering Elective Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective 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 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory				

Course L1525: Automat	tion and Simulation	
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	NN	
Language	DE	
Cycle	SoSe	
	Structure of automation systsems	
	Aufbau von Automationseinrichtungen	
	Structure and function of process computers and corresponding componentes	
	Data transfer via bus systems	
Contont	Programmable Logic Computers	
content	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.	
	U. Tietze, Ch. Schenk: Halbleiter-Schaltungstechnik; Springer Verlag	
	R. Lauber, P. Göhner: Prozessautomatisierung 2, Springer Verlag	
Literature	Färber: Prozessrechentechnik (Grundlagen, Hardware, Echtzeitverhalten), Springer Verlag	
	Einführung/Tutorial Matlab/Simulink - verschiedene Autoren	

ourse L1527: Automation and Simulation		
Recitation Section (large)		
2		
3		
Independent Study Time 62, Study Time in Lecture 28		
NN		
DE		
SoSe		
See interlocking course		
See interlocking course		

Module M1156: S	ystems Engineering			
Courses				
Title Systems Engineering (L154	7)	Typ Lecture	Hrs/wk	CP 4
Systems Engineering (L154	8)	Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students are able to: • understand systems engineering process models, methods and tools for the development of complex Systems • describe innovation processes and the need for technology Management • explain the aircraft development process and the process of type certification for aircraft • explain the system development process, including requirements for systems reliability • identify environmental conditions and test procedures for airborne Equipment • value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (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: • understand their responsibilities within a develo in the overall process	pment team and integrate	themselves	with their role
Autonomy	Students are able to: • interact and communicate in a development tear	m which has distributed ta	sks	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: 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 Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory			

Course L1547: Systems	s Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: 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: T	urbomachinery			
Courses				
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Franz Joos	-		
Admission Requirements	None			
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics	, Heat Transfer		
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence	The students can			
Knowledge	 alsunguish the physical phenomena of cc understand the different mathematic mo calculate and evaluate turbomachinery. The students are able to	delling of turbomachinery,		
Skills	 - 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 a 	pproach.		
Autonomy	 The students are able to develop a complex problem self-consiste analyse the results in a critical way, have an qualified exchange with other st 	nt, udents.		
Workload in Hours	Independent Study Time 124, Study Time in Leo	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineer Energy Systems: Specialisation Energy Systems Product Development, Materials and Produ Compulsory Product Development, Materials and Production Product Development, Materials and Production Theoretical Mechanical Engineering: Technical O Theoretical Mechanical Engineering: Specialisat	ring: Elective Compulsory :: Elective Compulsory ction: Specialisation Produ : Specialisation Production: E : Specialisation Materials: Ele Complementary Course: Election ion Energy Systems: Elective	Ict Developr Elective Comp ective Compuls Compuls Compulsory	ment: Elective pulsory Jlsory ory ,
Course L1562: Turbom	achines			
Тур	Lecture			

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: 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	
СР	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	

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Module M1170: P	henomena and Methods in Ma	aterials Science		
Courses				
Title Experimental Methods for the Phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer that the phase equilibria and transformer the phase equilibria and transformer that the phase equilibria and transformer the phase equilibria and transf	ne Characterization of Materials (L1580) rmations (L1579)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. V	Nerkstoffwissenschaft I/I	I	
Educational Objectives	After taking part successfully, students have	e reached the following l	learning results	
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence				
Social Competence	The students are able to present solutions t	o specialists and to deve	elop ideas further.	
Autonomy	The students are able to • assess their own strengths and weak • gather new necessary expertise by th	nesses. neir own.		
Workload in Hours	Independent Study Time 124 Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Materials Science: Core qualification: 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: Compulsory Product Development, Materials and Production: Specialisation Materials: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory			

Course L1580: Experimental Methods for the Characterization of Materials

Тур	Lecture
Hrs/wk	2
СР	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 e	quilibria and transformations
Тур	Lecture
Hrs/wk	2
СР	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: M	lechanical Properties				
Courses					
Title Mechanical Behaviour of Bri Dislocation Theory of Plastic	Title Typ Hrs/wk CP Mechanical Behaviour of Brittle Materials (L1661) Lecture 2 3 Dislocation Theory of Plasticity (11662) Lecture 2 3				
Module Responsible	Dr. Erica Lilleodden				
Admission Requirements	None				
Recommended Previous Knowledge	Basics in Materials Science I/II				
Educational Objectives	After taking part successfully, students ha	ve reached the following le	arning results		
Professional Competence					
Knowledge	Students can explain basic principles of thermodynamics (energy minimization, er	crystallography, statics (fr nergy barriers, entropy)	ee body diagrams,	, tractions) and	
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations				
Personal Competence					
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.				
Students are able to					
	- assess their own strengths and weaknesses				
Autonomy	, - assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.				
	- work independently based on lectures and notes to solve problems, and to ask for h clarifications when needed				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Nritten exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	Materials Science: Core qualification: Com Mechanical Engineering and Management Product Development, Materials and Compulsory Product Development, Materials and Product Product Development, Materials and Product Theoretical Mechanical Engineering: Speci Theoretical Mechanical Engineering: Tech	pulsory : Specialisation Materials: E Production: Specialisation uction: Specialisation Produ uction: Specialisation Mater ialisation Materials Science: nical Complementary Cours	lective Compulsory Product Develop ction: Elective Com ials: Compulsory : Elective Compulso ie: Elective Compuls	ment: Elective pulsory ry sory	

Course L1661: Mechani	ical Behaviour 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
	Theoretical Strength Of a perfect crystalline material, theoretical critical shear stress
	Real strength of brittle materials Energy release reate, stress intensity factor, fracture criterion
	Defect distribution, strength distribution, Weibull distribution
	Internal stresses, micro cracks, weight function,
	Heterogeneous materials II Toughening mechanisms: crack bridging, fibres
Content	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
	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
Literature	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: Dislocat	ion 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
	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.
Content	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: C	ptimal and Robust Control			
Title		Typ	Hrc/wk	CP
Optimal and Robust Control	(L0658)	Lecture	пг5/wк 2	3
Optimal and Robust Control	(L0659)	Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	 Classical control (frequency response, roo State space methods Linear algebra, singular value decomposit 	t locus) ion		
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional				
Competence				
Knowledge	 Students can explain the significance or problems. They can explain the duality between option of the state of the st	f the matrix Riccati equat mal state feedback and opt infinity norms are used plem can be formulated as s can be represented in a wa nall gain theorem - a robus plant. sis conditions on feedback l	ion for the imal state e to represer pecial case ny that lends st controller oops can be	solution of LQ stimation. It stability and of an H2 design is itself to robust can guarantee e represented as
Skills	 Students are capable of designing and tur They are capable of representing a H2 or plant, and of using standard software tool They are capable of translating time and constraints on closed-loop sensitivity func They are capable of constructing an LF designing a mixed-objective robust contro They are capable of formulating analysis (LMI), and of using standard LMI-solvers for They can carry out all of the above using standard the solve usi	hing LQG controllers for mult H-infinity design problem is s for solving it. frequency domain specifica- tions, and of carrying out a T uncertainty model for ar iller. and synthesis conditions a pr solving them. standard software tools (Ma	tivariable plant the form of ations for comixed-sension uncertain as linear mathematical tab robust of the total tab robust of t	ant models. of a generalized ontrol loops into tivity design. system, and of utrix inequalities control toolbox).
Personal Competence				
Social Competence Autonomy	Students can work in small groups on specific pr Students are able to find required information i documentation) and use it to solve given probler	oblems to arrive at joint solu n sources provided (lecture ns.	utions. e notes, liter	rature, software
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence En Electrical Engineering: Specialisation Control and Energy Systems: Core qualification: Elective Con Aircraft Systems Engineering: Specialisation Airc Computational Science and Engineering: Speci Compulsory Mechatronics: Specialisation Intelligent Systems Mechatronics: Specialisation System Design: Elee Biomedical Engineering: Specialisation Artifi Compulsory Biomedical Engineering: Specialisation Implants Biomedical Engineering: Specialisation Managern Product Development, Materials and Product Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C	gineering: Elective Compuls Power Systems: Elective C npulsory raft Systems: Elective Comp alisation Systems Engineer and Robotics: Elective Comp cive Compulsory cial Organs and Regene and Endoprostheses: Elective echnology and Control Thee tent and Business Administr tion: Specialisation Production: E Specialisation Materials: Elec complementary Course: Election	sory ompulsory pulsory ring and Ro pulsory rative Mec ry: Elective cory: Elective ration: Elective cation: Elective cation: Elective compulso clective Computive Computive compul	botics: Elective dicine: Elective ory Compulsory ve Compulsory yment: Elective npulsory ulsory sory

Course L0658: Optimal	and Robust Control
Тур	Lecture
Hrs/wk	2
СР	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 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 M1343: F	ibre-polymer-composites				
Courses					
TitleTypHStructure and properties of fibre-polymer-composites (L1894)Lecture2Design with fibre-polymer-composites (L1893)Lecture2			Hrs/wk 2 2	CP 3 3	
Module Responsible	Prof. Bodo Fiedler				
Admission Requirements	None				
Recommended Previous Knowledge	Basics: chemistry / physics / materials so	ience			
Educational Objectives	After taking part successfully, students h	ave reached the following leave	earning results		
Professional Competence	Charles have been been a start of Char			ha ha sha shekara	
	/ matrix) and define the necessary testin	g and analysis.	P) and its constituen	ts to play (fibe	
Knowledge	They can explain the complex relationsh	ips structure-property relati	onship and		
	the interactions of chemical structure o including to explain neighboring context	f the polymers, their proces s (e.g. sustainability, environ	ssing with the differ nmental protection).	ent fiber types	
	Students are capable of				
Skills	 using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. approximate sizing using the network theory of the structural elements implement and evaluate. selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance. 				
Personal Competence					
	Students can				
Social Competence	 arrive at funded work results in heterogenius groups and document them. provide appropriate feedback and handle feedback on their own performance constructively. 				
	Students are able to				
	 assess their own strengths and weakned 	sses.			
4	- assess their own state of learning in specific terms and to define further work steps on this basis.				
Autonomy	- assess possible consequences of their professional activity.				
Workload in Hours	Independent Study Time 124. Study Tim	e in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	180 min				
Assignment for the Following Curricula	Energy Systems: Core qualification: Elect Aircraft Systems Engineering: Specialisai Aircraft Systems Engineering: Specialisai International Management and Enginee Elective Compulsory Materials Science: Specialisation Enginee Mechanical Engineering and Managemen Product Development, Materials and Pro- Product Development, Materials and Pro- Renewable Energies: Specialisation Bioe Renewable Energies: Specialisation Solar Theoretical Mechanical Engineering: Spe-	tive Compulsory tion Cabin Systems: Elective tion Air Transportation Syste ring: Specialisation II. Proc ering Materials: Elective Com th: Core qualification: Compu- Production: Specialisation duction: Specialisation Prod duction: Specialisation Materials energy Systems: Elective Cor I Energy Systems: Elective Cor clalisation Materials Science	e Compulsory ems: Elective Compu- duct Development a npulsory ulsory n Product Develop uction: Elective Com- rials: Compulsory compulsory Compulsory compulsory e: Elective Compulsor	ilsory and Production ment: Elective pulsory	

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

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

Module M1344: P	rocessing of fibre-polymer	-composites		
Courses				
Title Processing of fibre-polymer-composites (L1895)		Тур Lecture	Hrs/wk 2	СР 3
From Molecule to Composite	es Part (L1516)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge in the basics of chemistry /	physics / materials science		
Educational Objectives	After taking part successfully, students	have reached the following learning	ng results	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes 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.			uring processes communicating plain the typical
	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents (fib matrix) and define the necessary testing and analysis.			
Skills	They can explain the complex structure	-property relationship and		
	the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of 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.			
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory			

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

Course L1516: From Mo	plecule to Composites Part
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	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")

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Module M0563: R	obotics			
Courses				
Title Robotics: Modelling and Cor Robotics: Modelling and Cor	Title Robotics: Modelling and Control (L0168) Robotics: Modelling and Control (L1305)		Hrs/wk 3 2	CP 3 3
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence	Students are able to describe fundamental properties of relate and colution approaches for multiple			nes for multiple
Knowledge	problems in robotics. Students are able to derive and solve equations of motion for various manipulators.			
Skills	Students can generate trajectories in various coordinate systems. Students can design linear and partially nonlinear controllers for robotic manipulators.			
Personal Competence Social Competence Autonomy	Students are able to work goal-oriented in small Students are able to recognize and improve know With instructor assistance, students are able to e course of study.	mixed groups. wledge deficits independent evaluate their own knowledg	ly. ge level and	define a further
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechanical Engineering and Management: Core qualification: Compulsory Mechatronics: Core qualification: 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

Course L0168: Robotics	s: 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	

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Module M0771: F	light Physics			
Courses				
Title Aerodynamics and Flight Me Flight Mechanics II (L0730) Flight Mechanics II (L0731)	echanics I (L0727)	Typ Lecture Lecture Recitation Section (large)	Hrs/wk 3 2 1	CP 3 2 1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Workload in Hours	Independent Study Time 96 Study Time i	a Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualifi International Management and Engineerin Product Development, Materials and Compulsory Product Development, Materials and Produ Product Development, Materials and Produ Theoretical Mechanical Engineering: Speci Theoretical Mechanical Engineering: Techi	ation: Compulsory g: Specialisation II. Aviation Syste Production: Specialisation Produ uction: Specialisation Production: E uction: Specialisation Materials: Ele alisation Aircraft Systems Enginee nical Complementary Course: Elec	ms: Elective Ict Develop Elective Com ective Comp ering: Electiv tive Compul	Compulsory ment: Elective pulsory ulsory e Compulsory sory

Тур	Lecture
Hrs/wk	3
CP	3
Norkload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
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	
Lecturer	Prof. Frank Thielecke, Mike Montel	
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. Frank Thielecke, Mike Montel	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0815: P	roduct Planning			
Courses				
Title		Тур	Hrs/wk	СР
Product Planning (L0851)		Project-/problem-based Learning	3	3
Product Planning Seminar (I	_0853)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt			
Admission Requirements	None			
Recommended Previous Knowledge	Good basic-knowledge of Business Administration	ſ		
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
	Students will gain insights into:			
Knowledge	 Product Planning Process Methods Design thinking Process Methods 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 instrum 	nents		
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 Lect	ure 70		
Credit points	6			
Course achievement	CompulsorBonus Form Yes 20 % Subject theoretical opractical work	Description and		
Examination	Written exam			
Examination duration	90 minutes			
and scale	Global Innovation Managements Core qualification	n: Compulson		
Assignment for the Following Curricula	Global Technology and Innovation Management. Core qualification Global Technology and Innovation Management & International Management and Engineering: Compulsory Mechanical Engineering and Management: Specia Product Development, Materials and Product Compulsory Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Specialisa Compulsory	Sentrepreneurship: Core of Specialisation I. Electiv alisation Management: Electiv tion: Specialisation Prod Specialisation Production: Specialisation Materials: El tion Product Development	ualification: C ves Manager ctive Compuls uct Developi Elective Comp lective Comp nt and Produ	Compulsory ment: Elective sory ment: Elective pulsory ulsory uction: Elective

Course L0851: Product	Planning
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	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 Voluntary presentations in the third hour (articles / case studies) Guest lectures by researchers Lecture on Sustainability with frequent reference to current research Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

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

Module M0830: Environmental Protection and Management					
Courses					
Title Integrated Pollution Control Health, Safety and Environr Health, Safety and Environr	(L0502) nental Management (L0387) nental Management (L0388)	Typ Lecture Lecture Recitation Section (small)	Hrs/wk 2 2 1	CP 2 3 1	
Module Responsible					
Admission					
Requirements	None				
Recommended Previous Knowledge	 Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) Good knowledge of the relevant Environmental Legislation Basic knowledge of instruments for Environmental Assessment 				
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results		
Professional Competence					
Knowledge	The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.				
Skills	Students are able to assess current problems and situations in the field of environmental protection They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical administrative and legislative level.				
Personal Competence	The students can work together in international gro	ups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributior to the discussions. They can acquire appropriate knowledge by making enquiries independently.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core qualification: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: 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 Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory				
Course L0502: Integrat	ed Pollution Control				
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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 				
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 Environmental Management
Тур	Lecture
Hrs/wk	2
СР	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	

	roduction Planning & Control and	Digital Enterprise		
Courses				
Title The Digital Enterprise (L0932) Production Planning and Control (L0929) Production Planning and Control (L0930) Exercise: The Digital Enterprise (L0933)		Typ Lecture Lecture Recitation Section (small) Recitation Section (small)	Hrs/wk 2 2 1 1	CP 2 2 1 1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Production and Quality Management			
Educational Objectives	After taking part successfully, students have reach	ned the following learning i	results	
Professional Competence Knowledge Skills	Students can explain the contents of the module in detail and take a critical position to them. Students are capable of choosing and applying models and methods from the module to industrial problems.			
Personal Competence Social Competence Autonomy	Students can develop joint solutions in mixed teams and present them to others. -			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	written exam			
and scale	180 Minuten			
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

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

Course L0929: Production Planning and Control		
Тур	Lecture	
Hrs/wk	2	
СР	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 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	rs/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		
	Siehe korrespondierende Vorlesung		
Literature	See interlocking course		

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Module M0962: S	ustainability and Risk Man	agement		
Courses				
Title Safety, Reliability and Risk <i>J</i> Environment and Sustainab	Assessment (L1145) ility (L0319)	Typ Seminar Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students	s have reached the following lea	arning results	
Professional Competence				
Knowledge	 assessment as well as environmental a basics in safety and reliability of safety and reliability analysis mention risk assessment Production and usage of bio-cha energy production and supply sustainable product design 	nd sustainable engineering, in f technical facilities ethods	detail:	
Skills	Students are able apply interdisci sustainability reporting. They can eva feasible treatment concepts.	plinary system-oriented met luate the effort and costs for p	hods for risk as processes and sele	ssessment and ct economically
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the su Furthermore, they can define target management and sustainability conce impact.	bject area from given sources s for new application or res pts accordance with the poter	and transform it to earch-oriented dut ntial social, econon	new questions. ties in for risk nic and cultural
Workload in Hours	Independent Study Time 124, Study Ti	me in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minu	tes in groups)		
Assignment for the Following Curricula	Civil Engineering: Core qualification: Co International Management and Engine Product Development, Materials an Compulsory Product Development, Materials and Pi Product Development, Materials and Pi Water and Environmental Engineering:	ompulsory ering: Specialisation II. Civil Eng d Production: Specialisation roduction: Specialisation Produc roduction: Specialisation Materi Core qualification: Compulsory	gineering: Elective Product Develop ction: Elective Comp als: Elective Comp /	Compulsory ment: Elective pulsory ulsory

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: Environr	ment and Sustainability
Тур	Lecture
Hrs/wk	2
СР	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.
Literature	Wird in der Veranstaltung bekannt gegeben.

Module M1024: M	lethods of Integrated Produc	t Development		
Courses				
Title Integrated Product Develop	ment II (L1254)	Typ Lecture	Hrs/wk 3	CP 3
Integrated Product Develop	ment II (L1255)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of Integrated product dev	velopment and applying CAE systemeters	ems	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	After passing the module students are abl • explain technical terms of design m • describe essential elements of cons	e to: ethodology, truction management,		
Skills	 describe current problems and the current state of research of integrated product development. After passing the module students are able to: select and apply proper construction methods for non-standardized solutions of problems as well 			
Personal Competence	 solve product development problem choose and execute appropriate model 	 solve product development problems with the assistance of a workshop based approach, choose and execute appropriate moderation techniques. 		
Social Competence	 After passing the module students are able to: prepare and lead team meetings and moderation processes, 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			
Course achievement				
Examination duration and scale	30 Minuten			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisati Aircraft Systems Engineering: Specialisati International Management and Engineeri Elective Compulsory Mechatronics: Specialisation System Desig Product Development, Materials and Produ Product Development, Materials and Produ Product Development, Materials and Produ Theoretical Mechanical Engineering: Techn Theoretical Mechanical Engineering: Spe Compulsory	on Cabin Systems: Elective Comp on Air Transportation Systems: Ele ing: Specialisation II. Product De gn: Elective Compulsory Jction: Specialisation Product Dev Jction: Specialisation Production: Jction: Specialisation Materials: El nical Complementary Course: Elec ecialisation Product Developmer	ulsory ective Compu- ective Compent: C Elective Compective Compective Compu- tive Compul tt and Prod	ulsory and Production: ompulsory nulsory ulsory sory uction: Elective

Course L1254: Integrat	ed Product 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
	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, Sustaination provide a selection
	 Systematic material selection, Assembly oriented design,
	Construction management
Content	 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. 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 Development II		
Тур	Project-/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 M1155: A	ircraft Cabin Systems			
Courses				
Title Aircraft Cabin Systems (L15 Aircraft Cabin Systems (L15	45) 46)	Typ Lecture Recitation Section (large)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	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 Systems 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 discus	ss their ideas with experts		
Autonomy	Students are able to: • Reflect the contents of lectures and expert prese	entations self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
Course achievement	None			
Examination	written exam			
and scale	120 Minutes			
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L1545: Aircraft	Cabin Systems
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
	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.
Content	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 M1025: F	luidics				
Courses					
Title Fluidics (L1256) Fluidics (L1371)			Typ Lecture Project-/problem-based	Hrs/wk 2 1	CP 3 2
Fluidics (L1257)			Learning Recitation Section (large)	1	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge	Good knowledge of me mechanics, and engine	chanics (stereo statics, ela ering design	astostatics, hydrostatics, kir	nematics and	d kinetics), fluid
Educational Objectives	After taking part succes	ssfully, students have read	ched the following learning	results	
Professional Competence					
Knowledge	After passing the modu • explain structure • explain the inter • explain open and • describe function well as centrifug	and functionalities of hy action of hydraulic compo d closed loop control of hy ning and applications of hy al pumps and aggregates	rdrostatic, pneumatic, and h nents in hydraulic systems, draulic systems, /drodynamic torque conver in plant technology	nydrodynam ters, brakes	ic components, and clutches as
Skills	After passing the modu analyse and assu- design and dime perform numeric select and adapt dimension hydro	ile students are able to ess hydraulic and pneuma ension hydraulic systems fo cal simulations of hydraulic c pump characteristic curv dynamic torque converter	tic components and system or mechanical applications, c systems based on abstrac es for hydraulic systems 's and brakes for mechanica	is, t problem de al aggregate	efinitions, s.
Personal Competence					ļ
Social Competence	 4fter 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. 				
Workload in Hours	Independent Study Tim	ne 124, Study Time in Lect	ure 56		
Credit points	6				
Course achievement	Compulsor Bonus Yes None	Form Attestation	Description Simulation hydrostatisc	her Systeme	2
Examination	Written exam				
Examination duration and scale	90				
Assignment for the Following Curricula	International Managem International Managem Elective Compulsory Product Development, Product Development, Product Development, Theoretical Mechanica Compulsory Theoretical Mechanical	ent and Engineering: Spec nent and Engineering: Sp Materials and Production: Materials and Production: Materials and Production: I Engineering: Specialisa Engineering: Technical Co	cialisation II. Mechatronics: ecialisation II. Product Deve Specialisation Product Deve Specialisation Production: E Specialisation Materials: Ele tion Product Developmento omplementary Course: Electon	Elective Con velopment a elopment: Co ective Comp t and Produ tive Compuls	npulsory and Production: pmpulsory pulsory ulsory uction: Elective sory

Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Dieter Krause DE WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
Hrs/wk CP Workload in Hours Lecture Language Cycle	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Dieter Krause DE WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Dieter Krause DE WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
Workload in Hours Lecture Language Cycle	Independent Study Time 62, Study Time in Lecture 28 Prof. Dieter Krause DE WiSe Lecture Hydrostatics
Lecturei Language Cycle	Prof. Dieter Krause DE WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
Language Cycle	DE WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
Cycle	WiSe Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
	Lecture Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines
Content	 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
	Field tripfield trip to a regional company from the hydraulic industry.
	Exercise Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model • simulation of common components • variation of simulation parameters • using simulations for system dimensioning and optimisation • (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

Typ Project-/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	Course L1371: Fluidics	
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	Тур	Project-/problem-based Learning
CP 2 Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause DE Cycle WiSe	Hrs/wk	1
Workload in Hours Independent Study Time 46, Study Time in Lecture 14 Lecturer Prof. Dieter Krause Language DE Cycle WiSe	СР	2
Lecturer Prof. Dieter Krause Language DE Cycle WiSe	Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Language DE Cycle WiSe	Lecturer	Prof. Dieter Krause
Cycle WiSe	Language	DE
	Cycle	WiSe
Content See interlocking course	Content	See interlocking course
Literature See interlocking course	Literature	See interlocking course

Course L1257: Fluidics	
Тур	Recitation Section (large)
Hrs/wk	1
СР	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 M1183: L	aser systems and method	s of manufacturing o	lesign and ana	lysis
Courses				
Title Laser Systems and Process	Technologies (L1612)	Typ Lecture	Hrs/wk 2	CP 3
Methods for Analysing Produ	uction Processes (L0876)	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, student	ts have reached the following l	earning results	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Workload in Hours	Independent Study Time 124 Study T	ime in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development, Materials a Compulsory Product Development, Materials and I Product Development, Materials and I Theoretical Mechanical Engineering: Compulsory Theoretical Mechanical Engineering: 1	nd Production: Specialisation Production: Specialisation Prod Production: Specialisation Mate Specialisation Product Deve Fechnical Complementary Cour	n Product Developm uction: Compulsory rials: Elective Compuls lopment and Product se: Elective Compulso	ent: Elective sory tion: Elective ry

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	
СР	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 Manual M.Sc. "Product Development, Materials and Production" $\ensuremath{\mathsf{N}}$

Module M1342: P	olymers			
Courses				
Title Structure and Properties of Processing and design with	Polymers (L0389) polymers (L1892)	Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Module Responsible	Dr. Hans Wittich			
Admission Requirements	None			
Recommended Previous Knowledge	Basics: chemistry / physics / material sciene	ce		
Educational Objectives	After taking part successfully, students hav	e reached the following l	earning results	
Professional				
competence	Students can use the knowledge of plastics	and define the necessar	y testing and analysi	is.
	They can explain the complex relationships	structure-property relati	onshin and	
Knowledge	the interactions of chemical structure of the sustainability, environmental protection).	ne polymers, including to	explain neighboring	g contexts (e.g.
	Students are capable of			
Skills	 using standardized calculation methods strength) to calculate and evaluate the difference 	s in a given context to erent materials.	mechanical prope	rties (modulus,
	 selecting appropriate solutions for me corrosion resistance. 	chanical recycling probl	ems and sizing exa	ample stiffness,
Personal Competence				
	Students can			
	- arrive at funded work results in heterogenius groups and document them.			
Social Competence	 provide appropriate feedback and handle 	feedback on their own pe	erformance construc	tively.
	Students are able to			
	- assess their own strengths and weakness	20		
Autonomy				
	- assess their own state of learning in specific terms and to define further work steps on this basis.			
	- assess possible consequences of their professional activity.			
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
and scale	180 min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineerin Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Man Biomedical Engineering: Specialisation Med Product Development, Materials and Produc Product Development, Materials and Produc Product Development, Materials and P Compulsory Theoretical Mechanical Engineering: Techni Theoretical Mechanical Engineering: Special	ng Materials: Elective Cor lants and Endoprosthese: Artificial Organs and agement and Business A ical Technology and Com- ction: Specialisation Prod tition: Specialisation Mate roduction: Specialisatior cal Complementary Cour lisation Materials Science	npulsory s: Compulsory Regenerative Med dministration: Elective trol Theory: Elective uction: Elective Comp rials: Elective Compulso se: Elective Compulso	icine: Elective ve Compulsory Compulsory pulsory ulsory ment: Elective sory

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

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

Module M1185: Specific Regulation	Technical Complementary (ons)	Course for PEPMS	(according to	Subject
Courses				
Title		Тур	Hrs/wk	СР
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	See selected module according to FSPO			
Educational Objectives	After taking part successfully, students h	ave reached the following le	arning 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	Depends on choice of courses			
Credit points	6			
Assignment for the Following Curricula	Product Development, Materials and Compulsory Product Development, Materials and Proc Product Development, Materials and Proc	Production: Specialisation duction: Specialisation Produ duction: Specialisation Mater	Product Developme Iction: Elective Compu rials: Elective Compuls	ent: Elective Isory ory

Systems (L2329)	Typ Lecture	Hrs/wk 4	CP 4
Systems (L2331)	Project-/problem-based	1	1
Systems (L2330)	Recitation Section (small)	1	1
ems (L1591)	Lecture	2	2
ems (L1738)	Recitation Section (small)	1	1
39)	Recitation Section (small)	1	1
Prof. Thorsten Schüppstuhl			
None			
without major course assessment			
After taking part successfully, students have reach	ned the following learning	results	
 Students know the characteristic components of an automation systems and have good understanding of their interaction know methods for a systematical analysis of automation tasks and are able to use them have special competences in industrial robot based automation systems 			
Students are able to			
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 decisions.			
 Students are able to analyze automation tasks independently generate programs for robots and programs develop solutions for practice oriented tasks design safety concepts for automation appli assess consequences of their professional a 	mable logic devices autono s of automation independe cations ctions and responsibilities	omously ently	
ndependent Study Time 12, Study Time in Lecture	e 168		
) Non e			
None Nritton oxom			
120 min			
Product Development, Materials and Producti Compulsory Product Development, Materials and Production: S Product Development, Materials and Production: S Product Development, Materials and Producti Compulsory Product Development, Materials and Production: S Theoretical Mechanical Engineering: Technical Cor Theoretical Mechanical Engineering: Specialisati Compulsory Compulsory	on: Specialisation Produ pecialisation Production: C pecialisation Materials: Ele on: Specialisation Produ pecialisation Materials: Ele nplementary Course: Elect on Product Development on Product Development	ct Developm Compulsory ective Compu ict Developm ective Compulso t and Product t and Product	nent: Elective Isory nent: Elective Isory ory ction: Elective
	Systems (L2329) Systems (L2331) Systems (L2330) ms (L1591) ms (L1738) 20) Prof. Thorsten Schüppstuhl Jone vithout major course assessment After taking part successfully, students have reach Students • know the characteristic components of an a their interaction • know methods for a systematical analysis o • have special competences in industrial robo Students are able to • analyze complex Automation tasks • develop application based concepts and sol • design subsystems and integrate into one s • investigate and evaluate safety of machiner • create simple programs for robots and prog • design of circuit for pneumatic applications Students are able to find solutions for automation and handling tasks - develop solutions in a production environme epresent decisions. Students are able to • analyze automation tasks independently • generate programs for robots and program • develop solutions for practice oriented tasks • develop solutions for practice oriented tasks • develop solutions for practice oriented tasks • design safety concepts for automation appli • assess consequences of their professional appli • assess consequences of their professional a independent Study Time 12, Study Time in Lectures • forduct Development, Materials and Production: S * froduct Development, Materials and Productio: S * froduct Developme	Systems (L2329) Lecture Systems (L2331) Project-/problem-based Systems (L2330) Recitation Section (small) Mig (L1738) Recitation Section (small) Students A now the characteristic components of an automation systems and at their interaction Interpreter Advantation tasks Advelog application based concepts and solutions Interp	Systems (L2329) Typ Hrs/wk systems (L2331) Project-/problem-based Learning 1 systems (L2330) Recitation Section (small) 1 ims (L1738) Recitation Section (small) 1 ims (L1738) Recitation Section (small) 1 ims (L1738) Recitation Section (small) 1 into any construction (small) 1 1 into any construction (small any construction (small) 1 1 into any construction (stand any construction (small any construction (small any const

Course L2329: Automation Technology and Systems		
Тур	Lecture	
Hrs/wk	4	
CP	4	
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		

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

Course L2331: Automation Technology and Systems		
Тур	Project-/problem-based Learning	
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	See interlocking course	
Literature	See interlocking course	

Typ Recit Hrs/wk 1	itation Section (small)
Hrs/wk 1	
CP 1	
Workload in Hours Inde	ependent Study Time 16, Study Time in Lecture 14
Lecturer Prof.	f. Thorsten Schüppstuhl
Language DE	
Cycle SoSe	Se
Content See	e interlocking course
Literature See	e interlocking course

Course L1591: Handling and Assembly Systems			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
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	See interlocking course	
Literature	See interlocking course	

Course L1	590: Automation Technology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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 L1	739: Automation Technology	
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	SoSe	
Content	-Introduction to the production Automation including their different fields of application, importent terms, automation h -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 t	iistory and 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	

Thesis Module M-002: Master Thesis Courses Title Тур Hrs/wk CP Module Responsible Professoren der TUHH • According to General Regulations §21 (1): Admission At least 60 credit points have to be achieved in study programme. The examinations board Requirements decides on exceptions. Recommended **Previous Knowledge** Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence 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. Knowledge The students can place a research task in their subject area in its context and describe and critically assess the state of research. The students are able: • To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question. Skills 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 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 Social Competence appropriate to the addressees while upholding their own assessments and viewpoints convincingly. Students are able: To structure a project of their own in work packages and to work them off accordingly. Autonomy 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 Course achievement None **Examination** Thesis **Examination duration** According to General Regulations and scale Civil Engineering: Thesis: Compulsory 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 Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Assignment for the **Following Curricula** Materials Science: Thesis: Compulsory Mathematical Modelling in Engineering: Theory, Numerics, Applications: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory Ship and Offshore Technology: Thesis: Compulsory Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory Theoretical Mechanical Engineering: Thesis: Compulsory

Process Engineering: Thesis: Compulsory

Water and Environmental Engineering: Thesis: Compulsory