

# **Module Manual**

Master of Science (M.Sc.)

# Product Development, Materials and Production

Cohort: Winter Term 2016

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# **Table of Contents**

Table of Contents	2
Program description	4
Core qualification	6
Module M0523: Business & Management	6
Module M0524: Nontechnical Elective Complementary Courses for Master	<u>5</u> .
Module M0603: Nonlinear Structural Analysis	9
Module M0742: Thermal Engineering	11
Module M0751: Vibration Theory	13
Module M0808: Finite Elements Methods	14
Module M0846: Control Systems Theory and Design	16
Module M1150: Continuum Mechanics	18
Module M1151: Material Modeling	20
Module M1173: Applied Statistics	22
Module M1204: Modelling and Optimization in Dynamics	24
Module M0604: High-Order FEM	26
Module M0805: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics)	28
Module M0807: Boundary Element Methods	30
Module M0752: Nonlinear Dynamics	32
Module M1164: Practical Course Product Development, Materials and Production	33
Module M0806: Technical Acoustics II (Room Acoustics, Computational Methods)	35
Module M1140: Technical Complementary Course Core Studies for PEPMS (according to Subject Specific Regulations)	37
Module M1184: Research Project Product Development, Materials and Production	38
Module M1339: Design optimization and probabilistic approaches in structural analysis	39
Specialization Product Development	41
Module M0763: Aircraft Systems I	41
Module M1024: Methods of Integrated Product Development	43
Module M1025: Fluidics	45
Module M1193: Cabin Systems Engineering	48
Module M0511: Electricity Generation from Wind and Hydro Power	51
Module M0630: Robotics and Navigation in Medicine	55
Module M0996: Supply Chain Management	57
Module M0764: Aircraft Systems II	60
Module M0811: Medical Imaging Systems	62
Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)	64
Module M1143: Mechanical Design Methodology	84
Module M1144: Manufacturing with Polymers and Composites - From Molecule to Part	86
Module M1145: Automation and Simulation	88
Module M1156: Systems Engineering	90
Module M1161: Turbomachinery	92
Module M1170: Phenomena and Methods in Materials Science	94
Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)	96
Module M1226: Mechanical Properties	116
Module M0840: Optimal and Robust Control	119
Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)	121
Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)	141
Module M0563: Robotics	161
Modulo M0771: Elight Physics	163
Madula M0015, Draduat Dlamaina	165
Mediule M0220: Equipmental Protection and Management	167
Module M0850: Environmental Protection and Management  Module M0867: Production Planning & Control and Digital Enterprise	169
Madula M0000, Custainahility and Diek Managament	171
Madula M4000. Duaduation and Lagistics Management	
Module M1002: Production and Logistics Management	173
Module M1155: Aircraft Cabin Systems	176
Module M1174: Automation Technology and Systems	178
Module M1183: Laser systems and methods of manufacturing design and analysis	181
Module M1342: Polymers	183
Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)	185
Specialization Production	186
Module M0763: Aircraft Systems I	186
Module M0867: Production Planning & Control and Digital Enterprise	188
Module M1183: Laser systems and methods of manufacturing design and analysis	
Madula M1174: Automation Tachnology and Cystems	192
Madula M1100, Cabin Systems Engineering	195
Madula MOS11. Flactricity Conception from Wind and Livdys Davier	
Module M0511: Electricity Generation from Wind and Hydro Power	198
Module M0630: Robotics and Navigation in Medicine	202
Module M0996: Supply Chain Management	204
Module M0764: Aircraft Systems II	207
Module M0811: Medical Imaging Systems	209
Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)	211
Module M1143: Mechanical Design Methodology	231
Module M1144: Manufacturing with Polymers and Composites - From Molecule to Part	233

Module M1145: Automation and Simulation	235
Module M1156: Systems Engineering	237
Module M1161: Turbomachinery	239
Module M1170: Phenomena and Methods in Materials Science	241
Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)	243
Module M1226: Mechanical Properties	263
Module M0840: Optimal and Robust Control	266
Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)	268
Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)	288
Module M0563: Robotics	308
Module M0771: Flight Physics	310
Module M0815: Product Planning	312
Module M0830: Environmental Protection and Management	314
Module M0962: Sustainability and Risk Management	316
Module M1024: Methods of Integrated Product Development	318
Module M1002: Production and Logistics Management	320
Module M1025: Fluidics	323
Module M1155: Aircraft Cabin Systems	326
Module M1342: Polymers	328
Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)	330
Specialization Materials	331
Module M0763: Aircraft Systems I	331
Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)	333
Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)	353
Module M1193: Cabin Systems Engineering	373
Module M0511: Electricity Generation from Wind and Hydro Power	376
Module M0630: Robotics and Navigation in Medicine	380
Module M0996: Supply Chain Management	382
Module M0764: Aircraft Systems II	385
Module M0811: Medical Imaging Systems	387
Module M1143: Mechanical Design Methodology	389
Module M1144: Manufacturing with Polymers and Composites - From Molecule to Part	391
Module M1145: Automation and Simulation	393
Module M1156: Systems Engineering	395
Module M1161: Turbomachinery	397
Module M1170: Phenomena and Methods in Materials Science	399
Module M1226: Mechanical Properties	401
Module M0840: Optimal and Robust Control	404
Module M0563: Robotics	406
Module M0771: Flight Physics	408
Module M0815: Product Planning	410
Module M0830: Environmental Protection and Management	412
Module M0867: Production Planning & Control and Digital Enterprise	414
Module M0962: Sustainability and Risk Management	416
Module M1024: Methods of Integrated Product Development	418
Module M1002: Production and Logistics Management	420
Module M1155: Aircraft Cabin Systems	423
Module M1025: Fluidics	425
Module M1183: Laser systems and methods of manufacturing design and analysis	428
Module M1174: Automation Technology and Systems	430
Module M0719: Biomaterials and Regenerative Medicine	433
Module M1342: Polymers	436
Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)	438
Supplement Modules Core Studies	439
Module M0599: Integrated Product Development and Lightweight Design	439
Module M0726: Production Technology	442
Module M1009: Material Science Laboratory	445
Thesis	447
Module M-002: Master Thesis	447



## **Program description**

## Content

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

## Career prospects

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

## Learning target

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

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

## **Product Development**

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

## Materials

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

## Production

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

## **Program structure**

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

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

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



• Nontechnical elective complementary courses (catalog) (6 CP).

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

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

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

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

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



## **Core qualification**

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

Module M0523: Busi	ness & Management
Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
Recommended Previous Knowledge	INONE
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<ul> <li>Students are able to find their way around selected special areas of management within the scope of business management.</li> <li>Students are able to explain basic theories, categories, and models in selected special areas of business management.</li> <li>Students are able to interrelate technical and management knowledge.</li> </ul>
Skills	<ul> <li>Students are able to apply basic methods in selected areas of business management.</li> <li>Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.</li> </ul>
Personal Competence Social Competence	
Autonomy	preparation of material.
	Depends on choice of courses
Credit points	<u>  6</u>

## Courses

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



## Module M0524: Nontechnical Elective Complementary Courses for Master

Module Responsible Dagmar Richter

Admission Requirements None

Recommended Previous Knowledge

None

Educational Objectives After taking part successfully, students have reached the following learning results

## **Professional Competence**

#### The Nontechnical Academic Programms (NTA)

imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, 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
- Can communicate in a foreign language in a manner appropriate to the subject.

## Professional Competence (Skills)

In selected sub-areas students can

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

Skills



	beyond the technical relationship to the subject.
Personal Competence	
	Personal Competences (Social Skills)
	Students will be able
Social Competence	<ul> <li>to learn to collaborate in different manner,</li> <li>to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> <li>to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul>
	Personal Competences (Self-reliance)
Autonomy	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)
	Depends on choice of courses
Credit points	6

## Courses

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



Module M0603: Nonl	inear Structural Analysis			
Module Modos. Nom	incai ottucturai Anaiysis			
Courses				
Title		Тур	Hrs/wk	CP
Nonlinear Structural Analysis (L Nonlinear Structural Analysis (L		Lecture Recitation Section (small)	3 1	4 2
	·	Recitation Section (Small)	1	
Module Responsible	Prof. Alexander Düster			
Admission Requirements	None			
Recommended Previous	Mathematics I, II, III, Mechanics I, II, III, IV			
	Differential Equations 2 (Partial Differential Equations)			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence	! !			
Knowledge	Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and 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			
Autonomy	Students are able to + assess their knowledge by means of exercises and E-Learning.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 min			
Assignment for the Following Curricula	Product Development Materials and Production: Core qualification: Flective Compulsory			



Course L0277: Nonlinear St	ructural 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	1. Introduction 2. Nonlinear phenomena 3. Mathematical preliminaries 4. Basic equations of continuum mechanics 5. Spatial discretization with finite elements 6. Solution of nonlinear systems of equations 7. Solution of elastoplastic problems 8. Stability problems 9. Contact problems
Literature	<ul> <li>[1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014.</li> <li>[2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008.</li> <li>[3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001.</li> <li>[4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, 2008.</li> </ul>

Course L0279: Nonlinear St	urse 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: Ther	mal Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Engineering (L0023)		Lecture	3	5
Thermal Engineering (L0024)		Recitation Section (large)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, I	Heat Transfer		
Educational Objectives	After taking part successfully, students have reach	ned the following learning 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.		
,	Students are able to define independently tasks, ways to use the knowledge in practice.	to get new knowledge from existing	ng knowledge	as well as to find
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min			
Assignment for the Following Curricula	I 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	
Content	<ol> <li>Introduction</li> <li>Fundamentals of Thermal Engineering 2.1 Heat Conduction 2.2 Convection 2.3 Radiation 2.4 Heat transition 2.5 Combustion parameters 2.6 Electrical heating 2.7 Water vapor transport</li> <li>Heating Systems 3.1 Warm water heating systems 3.2 Warm water supply 3.3 piping calculation 3.4 boilers, heat pumps, solar collectors 3.5 Air heating systems 3.6 radiative heating systems</li> <li>Thermal traetment systems 4.1 Industrial furnaces 4.2 Melting furnaces 4.3 Drying plants 4.4 Emission control 4.5 Chimney calculation 4.6 Energy measuring</li> <li>Laws and standards 5.1 Buildings 5.2 Industrial plants</li> </ol>	
Literature	<ul> <li>Schmitz, G.: Klimaanlagen, Skript zur Vorlesung</li> <li>VDI Wärmeatlas, 11. Auflage, Springer Verlag, Düsseldorf 2013</li> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, Vieweg+Teubner Verlag, Wiesbaden 2009</li> <li>Recknagel, H.; Sprenger, E.; Schrammek, ER.: Taschenbuch für Heizung- und Klimatechnik 2013/2014, 76. Auflage, Deutscher Industrieverlag, 2013</li> </ul>	

Course L0024: Thermal Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0751: Vibra	tion Theory			
Courses				
Title Vibration Theory (L0701)		Typ Lecture	Hrs/wk	<b>CP</b> 6
Module Responsible	Prof. Norbert Hoffmann			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Calculus</li><li>Linear Algebra</li><li>Engineering Mechanics</li></ul>			
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	Students are able to denote terms and c	oncepts of Vibration Theory and de	velop them further.	
Skills	Students are able to denote methods of	Vibration Theory and develop them	further.	
Personal Competence				
Social Competence	Students can reach working results also	in groups.		
Autonomy	Students are able to approach individually research tasks in Vibration Theory.			
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56	•	
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 Hours			
Assignment for the Following Curricula  Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory  Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory  Product Development, Materials and Production: Core qualification: Compulsory  Naval Architecture and Ocean Engineering: Core qualification: Elective Compulsory  Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		mpulsory Isory		

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



Module M0808: Finite	e Elements Methods			
Courses				
Title Finite Element Methods (L0291) Finite Element Methods (L0804)		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements				
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mathematics I, II, III (in particular differential equa-	· •	natics, Dynamio	cs)
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence  Knowledge	The students possess an in-depth knowledge regive an overview of the theoretical and methodical		element metho	od and are able to
Skills	The students are capable to handle engineering corresponding system matrices, and solving the r		finite element	s, assembling the
Personal Competence Social Competence Autonomy			and develop (	own finite element
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	· · · · · · · · · · · · · · · · · · ·			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Civil Engineering: Core qualification: Compulsory Energy Systems: Core qualification: Elective Corn Aircraft Systems Engineering: Specialisation Airc Aircraft Systems Engineering: Specialisation Airc Computational Science and Engineering: Special International Management and Engineering: Special International Management and Engineering: Specialisation Artification: Compulsory Mechatronics: Core qualification: Compulsory Biomedical Engineering: Specialisation Artificial Giomedical Engineering: Specialisation Implants Biomedical Engineering: Specialisation Medical Biomedical Engineering: Specialisation Manager Product Development, Materials and Production: Technomathematics: Specialisation III. Engineeri Technomathematics: Core qualification: Elective Theoretical Mechanical Engineering: Core qualification: Core qualification:	rapulsory raft Systems: Elective Compulsory ransportation Systems: Elective C lisation Scientific Computing: Elec cialisation II. Mechatronics: Electiv pecialisation II. Product Develop  Organs and Regenerative Medicin and Endoprostheses: Compulsory rechnology and Control Theory: E nent and Business Administration: Core qualification: Compulsory ng Science: Elective Compulsory Compulsory	tive Compulso e Compulsory ment and Pro- e: Elective Con- lective Compu	oduction: Elective npulsory Isory



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 Eleme	ourse L0804: Finite 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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0846: Cont	rol Systems Theory and Design			
Courses				
Title		Тур	Hrs/wk	СР
Control Systems Theory and De Control Systems Theory and De	• ,	Lecture Recitation Section (small)	2	4 2
		necitation Section (Smail)	2	2
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	Introduction to Control Systems			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	Students can explain how linear dynamic the system response to initial states or exterminate the system response to initial states or exterminate the system properties feedback and state estimation, respectivel. They can explain the significance of a min. They can explain observer-based state disturbance rejection. They can extend all of the above to multi-in. They can explain the z-transform and its re. They can explain state space models and. They can explain state space models and. They can explain the experimental ide identification problem can be solved by so. They can explain how a state space model.	ernal excitation as trajectories in s controllability and observability, y imal realisation feedback and how it can be nput multi-output systems elationship with the Laplace Trans transfer function models of discret entification of ARX models of d lving a normal equation	ate space and their rela used to achie form e-time systems ynamic system	ationship to state eve tracking and as, and how the
Skills	<ul> <li>Students can transform transfer function models into state space models and vice versa</li> <li>They can assess controllability and observability and construct minimal realisations</li> <li>They can design LQG controllers for multivariable plants</li> <li>They can carry out a controller design both in continuous-time and discrete-time domain, and decide which is appropriate for a given sampling rate</li> <li>They can identify transfer function models and state space models of dynamic systems from experimenta data</li> <li>They can carry out all these tasks using standard software tools (Matlab Control Toolbox, System Identification Toolbox, Simulink)</li> </ul>		rom experimental	
Personal Competence				
Social Competence	Students can work in small groups on specific pro	blems to arrive at joint solutions.		
Autonomy	Students can obtain information from provided so and use it when solving given problems.  They can assess their knowledge in weekly on-lir	,	,	,
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy Systems: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Core qualification: 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: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Core qualification: Compulsory			



Tvn	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	WiSe
	State space methods (single-input single-output)
	State space models and transfer functions, state feedback
	Coordinate basis, similarity transformations
	Solutions of state equations, matrix exponentials, Caley-Hamilton Theorem
	Controllability and pole placement
	State estimation, observability, Kalman decomposition
	Observer-based state feedback control, reference tracking
	Transmission zeros
	Optimal pole placement, symmetric root locus
	Multi-input multi-output systems
	Transfer function matrices, state space models of multivariable systems, Gilbert realization
	Poles and zeros of multivariable systems, minimal realization
	Closed-loop stability
	Pole placement for multivariable systems, LQR design, Kalman filter
Content	- role placement for multivariable systems, Eqn design, Nathan inter
	Digital Control
	Discrete-time systems: difference equations and z-transform
	Discrete-time state space models, sampled data systems, poles and zeros
	• Frequency response of sampled data systems, choice of sampling rate
	System identification and model order reduction
	Least squares estimation, ARX models, persistent excitation
	Identification of state space models, subspace identification
	Balanced realization and model order reduction
	Case study
	Modelling and multivariable control of a process evaporator using Matlab and Simulink
	Software tools
	Matlab/Simulink
	Werner, H., Lecture Notes "Control Systems Theory and Design"
	T Kailath "Linear Systems" Prentice Hall 1980
Literature	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
СР	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: Cont	inuum Mechanics			
Courses				
Courses Title		Tun	Huo hule	CD
Continuum Mechanics (L1533)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Continuum Mechanics Exercise	e (L1534)	Recitation Section (small)	2	3
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	None			
-	Mechanics I			
Recommended Previous Knowledge	Mechanics II			
Educational Objectives	After taking part successfully, students	s have reached the following learning results		
Professional Competence	1			
Knowledge	The students can explain the fundamental concepts to calculate the mechanical behavior of materials.			
Skills	The students can set up balance law contexts as in research contexts.	rs and apply basics of deformation theory to	specific aspec	ts, both in applied
Personal Competence				
Social Competence	The students are able to present solut	tions to specialists and to develop ideas furthe	er.	
Autonomy		ir own strengths and weaknesses and to de um mechanics on their own.	fine tasks then	nselves. They car
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	13() min			
Assignment for the Following Curricula	Materials Science: Specialisation Moc Mechanical Engineering and Manage Mechatronics: Technical Complement Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Product Development, Materials and I Theoretical Mechanical Engineering:	ment: Specialisation Materials: Elective Com	pulsory ne: Elective Col mpulsory Elective Compu : Elective Compu ulsory	mpulsory

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



Course L1534: Continuum 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. Swantje Bargmann	
Language	DE/EN	
Cycle	WiSe	
Content	<ul> <li>kinematics of undeformed and deformed bodies</li> <li>balance equations (balance of mass, balance of energy,)</li> <li>stress states</li> <li>material modelling</li> </ul>	
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer	



Module M1151: Mate	rial Modeling			
Courses				
<b>Title</b> Material Modeling (L1535) Material Modeling (L1536)		Typ Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Swantje Bargmann			
Admission Requirements	None			
Recommended Previous Knowledge				
	continuum mechanics			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results	;	
Professional Competence				
Knowledge	The students can explain the fundamentals of m	ultidimensional consitutive materi	al laws	
Skills	The students can implement their own materia their knowledge to various problems of material			
Personal Competence				
Social Competence	The students are able to develop solutions, to present them to specialists and to develop ideas further.			
Autonomy	The students are able to assess their own stre solve exercises in the area of continuum mecha	•	efine tasks then	nselves. They ca
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	130 min			
•	Computational Science and Engineering: Speci Materials Science: Specialisation Modelling: Ele Mechanical Engineering and Management: Spe Biomedical Engineering: Specialisation Artificia Biomedical Engineering: Specialisation Implant Biomedical Engineering: Specialisation Medica Biomedical Engineering: Specialisation Manage Product Development, Materials and Production Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical	ective Compulsory cialisation Materials: Elective Con I Organs and Regenerative Medic s and Endoprostheses: Elective C I Technology and Control Theory: ement and Business Administratio 1: Core qualification: Elective Com tion Materials Science: Elective C	mpulsory ine: Elective Colompulsory Elective Compu n: Elective Compu pulsory ompulsory	mpulsory

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



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



Module M1173: Appl	ied Statistics			
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 statistical methods			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students can explain the statistical methods and the conditions of their use.			
Skills	Students are able to use the statistics program to solve statistics problems and to interpret and depict the results			
Personal Competence				
Social Competence	Team Work, joined presentation of results			
Autonomy	To understand and interpret the question and solve			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, 28 questions			
Assignment for the Following Curricula	Mechanical Engineering and Management: Specialis: Mechatronics: Specialisation System Design: Elective Mechatronics: Specialisation Intelligent Systems and Biomedical Engineering: Core qualification: Compulsi Product Development, Materials and Production: Core	Compulsory Robotics: Elective Compulsory ory	, ,	

Course L1584: Applied Stat	istics
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 Stat	tistics
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	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 Stat	istics
Тур	Recitation Section (small)
Hrs/wk	1
СР	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: Mode	elling and Optimization in Dynamics	3			
Courses	,				
Title		Тур	Hrs/wk	СР	
Flexible Multibody Systems (L10	632)	Lecture	2	3	
Optimization of dynamical syste	ems (L1633)	Lecture	2	3	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous Knowledge	<ul> <li>Mathematics I, II, III</li> <li>Mechanics I, II, III, IV</li> <li>Simulation of dynamical Systems</li> </ul>				
Educational Objectives	After taking part successfully, students have read	ched the following learning re	esults		
Professional Competence					
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 analyz multibody systems	e and optimize basic proble	ms of the dynamics o	f rigid and flexible	
	+ to describe dynamics problems mathematically				
l	+ to optimize dynamics problems				
Personal Competence				-	
r ersonar competence	Students are able to				
Social Competence	+ solve problems in heterogeneous groups and	to document the correspondi	ing results.		
Autonomy	Students are able to  + assess their knowledge by means of exercises.  + acquaint themselves with the necessary knowledge to solve research oriented tasks.				
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56			
Credit points	6				
Examination	Oral exam				
Examination duration and scale	30 min				
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory				



Course L1632: Flexible Multibody Systems		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	1. Basics of Multibody Systems 2. Basics of Continuum Mechanics 3. Linear finite element modelles and modell reduction 4. Nonlinear finite element Modelles: absolute nodal coordinate formulation 5. Kinematics of an elastic body 6. Kinetics of an elastic body 7. System assembly	
Literature	Schwertassek, R. und Wallrapp, O.: Dynamik flexibler Mehrkörpersysteme. Braunschweig, Vieweg, 1999.  Seifried, R.: Dynamics of Underactuated Multibody Systems, Springer, 2014.  Shabana, A.A.: Dynamics of Multibody Systems. Cambridge Univ. Press, Cambridge, 2004, 3. Auflage.	

Course L1633: Optimization of dynamical systems		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	WiSe	
Content	1. Formulation and classification of optimization problems 2. Scalar Optimization 3. Sensitivity Analysis 4. Unconstrained Parameter Optimization 5. Constrained Parameter Optimization 6. Stochastic optimization 7. Multicriteria Optimization 8. Topology Optimization	
Literature	Bestle, D.: Analyse und Optimierung von Mehrkörpersystemen. Springer, Berlin, 1994.  Nocedal, J., Wright, S.J.: Numerical Optimization. New York: Springer, 2006.	



Madula MOCOA: Link	Ouder EEM			
Module M0604: High	-Order FEM			
Courses				
Title		Тур	Hrs/wk	СР
High-Order FEM (L0280)		Lecture	3	4
High-Order FEM (L0281)		Recitation Section (large)	1	2
Module Responsible	Prof. Alexander Düster			
Admission Requirements	None			
Recommended Previous	Mathematics I, II, III, Mechanics I, II, III, IV			
	Differential Equations 2 (Partial Differential Equat	ions)		
Educational Objectives	After taking part successfully, students have reach	ned 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 res	sults.	
Autonomy	Students are able to + assess their knowledge by means of exercises are acquaint themselves with the necessary knowle		sks.	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 min			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Com Computational Science and Engineering: Special Materials Science: Specialisation Modelling: Elec Mechanical Engineering and Management: Scompulsory Mechatronics: Technical Complementary Course: Product Development, Materials and Production: Naval Architecture and Ocean Engineering: Core Theoretical Mechanical Engineering: Technical Core qualifications and Mechanical Engineering: Technical Core Theoretical Mechanical Engineering: Technical Core	isation Scientific Computing: Elective Compulsory Specialisation Product Develop Elective Compulsory Core qualification: Elective Compulsor qualification: Elective Compulsor cation: Elective Compulsory	ment and P ulsory y	



Course L0280: High-Order I	FEM
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	EN
Cycle	SoSe
Content	<ol> <li>Introduction</li> <li>Motivation</li> <li>Hierarchic shape functions</li> <li>Mapping functions</li> <li>Computation of element matrices, assembly, constraint enforcement and solution</li> <li>Convergence characteristics</li> <li>Mechanical models and finite elements for thin-walled structures</li> <li>Computation of thin-walled structures</li> <li>Error estimation and hp-adaptivity</li> <li>High-order fictitious domain methods</li> </ol>
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 I	ourse L0281: High-Order FEM	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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: Tech	nical Acoustics I (Acoustic Waves, Noi	se Protection, Psycho	Acoustic	s)
Courses				
,	Waves, Noise Protection, Psycho Acoustics ) (L0516) Waves, Noise Protection, Psycho Acoustics ) (L0518)	<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	none			
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics)  Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
	The students possess an in-depth knowledge in acoustics regarding acoustic waves, noise protection, and psychologics and are able to give an overview of the corresponding theoretical and methodical basis.  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 Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Compuls Aircraft Systems Engineering: Specialisation Cabin Sy International Management and Engineering: Specialis Mechatronics: Specialisation System Design: Elective Product Development, Materials and Production: Core Technomathematics: Core qualification: Elective Com Technomathematics: Specialisation III. Engineering S Theoretical Mechanical Engineering: Specialisation P Theoretical Mechanical Engineering: Technical Comp	rstems: Elective Compulsory sation II. Aviation Systems: Ele Compulsory qualification: Elective Compu pulsory cience: Elective Compulsory roduct Development and Proc	ulsory duction: Electiv	

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



Course L0518: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics )	
Тур	Recitation Section (large)
Hrs/wk	2
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



Module M0807: Bour	ndary Element Methods			
Courses				
Title		Тур	Hrs/wk	СР
Boundary Element Methods (L0		Lecture	2	3
Boundary Element Methods (L0	(524)	Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements				
Recommended Previous Knowledge	Mothomotica I II III (in particular differential equation		atics, Dynamio	cs)
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Vacuuladaa	The students possess an in-depth knowledge regable to give an overview of the theoretical and met		ındary elemen	t method and are
Knowledge Skills	The students are capable to handle engineering puthe corresponding system matrices, and solving the	,	boundary eler	nents, assembling
Personal Competence Social Competence Autonomy	The students are able to independently solve chelement routines. Problems can be identified and to			op own boundary
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engine Civil Engineering: Specialisation Geotechnical Engineering: Specialisation Coastal Enginee Energy Systems: Core qualification: Elective Comp Computational Science and Engineering: Specialis Mechanical Engineering and Management: Specialis Mechatronics: Specialisation System Design: Elector Product Development, Materials and Production: Computations: Specialisation III. Engineering: Technomathematics: Specialisation III. Engineering: Technomathematics: Core qualification: Elective Computation Mechanical Engineering: Core qualification: Elective Computations Mechanical Engineering: Technical Core qualifications Mechanical Engi	gineering: Elective Compulsory ring: Elective Compulsory bulsory sation Scientific Computing: Elect pecialisation Product Develope tive Compulsory Core qualification: Elective Compulsory ompulsory ation: Elective Compulsory	nent and Pro	•



Course L0523: Boundary E	lement 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 E	ourse 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	



Module M0752: Nonl	inear Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Nonlinear Dynamics (L0702)		Lecture	4	6
Module Responsible	Prof. Norbert Hoffmann			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Calculus</li><li>Linear Algebra</li><li>Engineering Mechanics</li></ul>			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
<b>Professional Competence</b>				
Knowledge	Students are able to reflect existing terms and terms and concepts.	concepts in Nonlinear Dyna	amics and to develop	and research nev
Skills	Students are able to apply existing methods at and procedures.	nd procesures of Nonlinear I	Dynamics and to devel	op novel method
Personal Competence				
Social Competence	Students can reach working results also in groups.			
Autonomy	Students are able to approach given research tasks individually and to identify and follow up novel research tasks by themselves.			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 Hours			
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 Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Specialisation System Design: 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 Theoretical Mechanical Engineering: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		mpulsory Isory		

Course L0702: Nonlinear Dynamics	
Тур	Lecture
Hrs/wk	4
СР	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 M1164: Practical Course Product Development, Materials and Production		
Courses		
Title Practical Course Product Devel	Typ Hrs/wk CP lopment, Materials and Production (L1566) Laboratory 6 6	
Module Responsible	Prof. Wolfgang Hintze	
Admission Requirements	none	
	Product Development:  Lectures: Mechanics I-III  Lectures: Integrated Product Development I incl. CAD practical training  Materials:  Lectures: Structural Metallic Materials, Metallic Materials for Aircraft Applications, Introduction to Materials	
Recommended Previous Knowledge	Testing  • Lectures: Structure and Properties of Polymers, Structure and Properties of Composites, Manufacturing of Polymers and Composites  Production:  • Lecture: Production Engineering • Lectures: Forming and Cutting Technology, Methods of production process design • Lectures: Machine Tools and Robotic	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	Students can  represent more complex context of different fields of study.  describe functionality of modern measurement instrumentations and machine technologies.	
Skills	<ul> <li>Students are capable of</li> <li>applying theoretical knowledge for practical applications.</li> <li>applying provided experimental methods for examining contexts of different fields of study.</li> <li>analyzing and evaluating experimental results by using provided methods.</li> <li>applying modern measurement instrumentations.</li> </ul>	
Personal Competence		
Social Competence	<ul> <li>carry out and document experimental work in groups.</li> <li>present and discuss experimental results in mixed teams of different fields of study.</li> </ul>	
Autonomy	Students are able to  carry out parts of experimental work independently guided by teachers. choose and apply suitable instruments. assess own strengths and weaknesses.	
	Independent Study Time 96, Study Time in Lecture 84	
Credit points		
	Written elaboration	
Examination duration and scale		
	Biomedical Engineering: Core qualification: Compulsory Product Development, Materials and Production: Core qualification: Compulsory	



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



Module M0806: Technical Acoustics II (Room Acoustics, Computational Methods)				
Courses				
Title		Тур	Hrs/wk	СР
Technical Acoustics II (Room A	coustics, Computational Methods) (L0519)	Lecture	2	3
Technical Acoustics II (Room A	coustics, Computational Methods) (L0521)	Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous Knowledge	Technical Acoustics I (Acoustic Waves, Noise Pro Mechanics I (Statics, Mechanics of Materials) and Mathematics I, II, III (in particular differential equa	d Mechanics II (Hydrostatics, Kinen	natics, Dynami	ics)
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge in acoustics regarding room acoustics and computational method and are able to give an overview of the corresponding theoretical and methodical basis.			
Skills	The students are capable to handle engined demanding computational methods and procedu		heory-based	application of the
Personal Competence				
Social Competence				
Autonomy	The students are able to independently solve module. Possible conflicting issues and limitation			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	20-30 Minuten			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cat Mechatronics: Specialisation System Design: Ele Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C Theoretical Mechanical Engineering: Specialisat	ective Compulsory  Core qualification: Elective Compr  Complementary Course: Elective C	ompulsory	ve Compulsory

	coustics II (Room Acoustics, Computational Methods)
	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: Technical Acoustics II (Room Acoustics, Computational 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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



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



Module M1184: Rese	earch Project Product Development, Materials and Production		
Courses			
Title	Тур	Hrs/wk	СР
Module Responsible	Dozenten des Studiengangs		
Admission Requirements	None		
Recommended Previous Knowledge	I 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	<ul> <li>Students can explain the project as well as their autonomously gained knowl issues of their field of study.</li> <li>They can explain the basic scientific methods they have worked with.</li> </ul>	edge and rel	ate it to current
Skills	results, and then can find new ways and methods for their work. Students are capable alternative approaches with their own with regard to given criteria.	draw conclus	sions from their
Personal Competence			
Social Competence	The students are able to condense the relevance and the structure of the project work, sub-problems for the presentation and discussion in front of a bigger group. They can la feedback on the project to their peers and supervisors.		
Autonomy	The students are capable of independently planning and documenting the work sconsidering the given deadlines. This includes the ability to accurately procure the number of the progress of the state of the art in science and technology.	newest scienti	fic information.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0		
Credit points	12		
Examination	Study work		
Examination duration and scale			
Assignment for the Following Curricula	Product Development, Materials and Production: Core qualification: Compulsory		



Module M1339: Design	gn optimization and probabilistic a	approaches in structural a	analysis	
Courses				
- '	bilistic Approaches in Structural Analysis (L1873) bilistic Approaches in Structural Analysis (L1874)	Typ Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	<u>.                                      </u>			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have re-	ached the following learning result	S	
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 reliability analysis		
Skills	Application of optimization algorithms a     Programming with Matlab     Implementation of algorithms     Debugging	and probabilistic methods in the des	sign of structures	
Personal Competence	,			
Social Competence	Team work  Oral explanation of the the work			
Autonomy	Application of methods learned in the fr     Familiarizing with source code provided     Description of approaches and results			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale				
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation A Aircraft Systems Engineering: Specialisation A Product Development, Materials and Production Product Development Materials and Production	ir Transportation Systems: Elective on: Core qualification: Elective Comen: Core qualification: Elective Comen: Core qualification: Elective Comen: Complementary Course: Elective alification: Elective Compulsory	Compulsory pulsory pulsory	



Course L1873: Design Opti	mization and Probabilistic Approaches in Structural Analysis
Тур	Lecture
Hrs/wk	2
СР	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 Tobust design optimization Robustness measures Coupling of design optimization and reliability analysis
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

Course L1874: Design Option	Course L1874: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	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	



## **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: Aircr	raft Systems I			
Courses				
Γitle		Тур	Hrs/wk	СР
Aircraft Systems I (L0735)		Lecture	3 2	4 2
Aircraft Systems I (L0739)	Durá Fural, Thislands	Recitation Section (large)	2	2
	Prof. Frank Thielecke  None			
Admission Requirements				
Recommended Previous Knowledge	I ● Thermodynamics			
Educational Objectives	After taking part successfully, students have reac	ned the following learning results		
Professional Competence		•		
Knowledge	Students are able to:  Describe essential components and desigence of the functionality of air Explain the need for high-lift systems such Assess the challenge during the design of	conditioning systems as ist functionality and effects	d high-lift syste	ems
Skills	Design hydraulic and electric supply syste     Design high-lift systems of aircrafts     Analyze the thermodynamic behaviour of			
Personal Competence				
•	Students are able to:			
Social Competence	Perform system design in groups and pre	sent and discuss results		
Autonomy	Students are able to:  • Reflect the contents of lectures autonomo	usly		
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	1			
	Written exam			
Examination duration and scale	I 165 Minutes			
Assignment for the Following Curricula	i roddol bevelopinent, waterials and i roddellon.	Compulsory cialisation II. Aviation Systems: Ele Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective on Aircraft Systems Engineering: E	ent: Elective Co e Compulsory Compulsory Elective Compu	ompulsory



Course L0735: Aircraft Sys	etems I
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	WiSe
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>

Course L0739: Aircraft Sys	ourse L0739: Aircraft Systems I	
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	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1024: Meth	ods of Integrated Product Developm	ent		
	·			
Courses				
Title		Тур	Hrs/wk	СР
Integrated Product Developmen	nt II (L1254)	Lecture	3	3
Integrated Product Developmen	nt II (L1255)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of Integrated product developme	ent and applying CAE systems		
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	After passing the module students are able to:  explain technical terms of design methodo describe essential elements of construction describe current problems and the current	n management,	oduct developr	nent.
Skills	After passing the module students are able to:  • select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions,  • solve product development problems with the assistance of a workshop based approach,  • choose and execute appropriate moderation techniques.			
Personal Competence				
Social Competence	After passing the module students are able to:  • 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 cr  • implement the accepted feedback autonor			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	130 Minuten			
	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 Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		ry	



se L1254: Integrated F	Product Development II
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
	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 warriets.
	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.
	Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.
	Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.      Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.
	Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.      Hartmann, M. Biogar, M. Fuelk, B. Beth, H.: Zielegriehtet moderieren, Ein Handbuch für Führungekräfte.      Hartmann, M. Biogar, M. Fuelk, B. Beth, H.: Zielegriehtet moderieren, Ein Handbuch für Führungekräfte.
Literature	<ul> <li>Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007.</li> </ul>
Literature	Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.
	Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000.
	<u> </u>

- Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.

Course L1255: Integrated P	ourse L1255: Integrated Product Development II	
Тур	Project-/problem-based Learning	
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	
Content	See interlocking course	
Literature	See interlocking course	



Module M1025: Fluid	ics			
Courses				
Title		Тур	Hrs/wk	CP
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Project-/problem-based Learning	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, ela and engineering design	astostatics, hydrostatics, kinematic	s and kinetics	), fluid mechanics,
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence			·	
Knowledge	<ul> <li>explain open and closed loop control of hy</li> <li>describe functioning and applications of l centrifugal pumps and aggregates in plant</li> </ul>	nents in hydraulic systems, draulic systems, nydrodynamic torque converters,	·	
Skills	After passing the module students are able to  • analyse and assess hydraulic and pneumatic components and systems,  • design and dimension hydraulic systems for mechanical applications,  • perform numerical simulations of hydraulic systems based on abstract problem definitions,  • select and adapt pump characteristic curves for hydraulic systems  • dimension hydrodynamic torque converters and brakes for mechanical aggregates.			
Personal Competence	After passing the module students are able to			
Social Competence	<ul> <li>discuss and present functional context in g</li> <li>organise teamwork autonomously.</li> </ul>	roups,		
Autonomy	After passing the module students are able to  obtain necessary knowledge for the simula	ation.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90			
Assignment for the	International Management and Engineering: Specinternational Management and Engineering: Specinternational Management and Engineering: Specinternational Special Special Special Special Mechanical Engineering: Special Special Mechanical Engineering: Technical Communications of the Special Mechanical Engineering: Technical Communications of the Special Special Special Special Special Mechanical Engineering: Technical Communications of the Special Specia	pecialisation II. Product Develop Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective on Product Development and Product Development Advance Development Advan	oment and Prent: Compulso e Compulsory Compulsory duction: Electiv	oduction: Elective



_			
	Lecture		
Hrs/wk	!		
СР	<u>3</u>		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	WiSe		
	Lecture		
	Lludvastotian		
	Hydrostatics		
	physical fundamentals		
	hydraulic fluids		
	<ul><li>hydrostatic machines</li><li>valves</li></ul>		
	• components		
	hydrostatic transmissions		
	examples from industry		
	December 2		
	Pneumatics		
	generation of compressed air		
	pneumatic motors		
	Examples of use		
	Hydrodynamics		
	physical fundamentals		
	hydraulic continous-flow machines     hydraulic manie transmissions		
	<ul> <li>hydrodynamic transmissions</li> <li>interoperation of motor and transmission</li> </ul>		
	Theroperation of motor and transmission		
	Exercise		
Content	Hydrostatics		
•			
	<ul> <li>reading and design of hydraulic diagrams</li> <li>dimensioning of hydrostatic traction and working drives</li> </ul>		
	performance calculation		
	Hydrodynamics		
	calculation / dimensioning of hydrodynamic torque converters		
	calculation / dimensioning of centrifugal pumps		
	<ul> <li>creating and reading of characteristic curves of pumps and systems</li> </ul>		
	Field trip		
	Tiola tip		
	<ul> <li>field trip to a regional company from the hydraulic industry.</li> </ul>		
	Exercise		
	Numerical simulation of hydrostatic systems		
	<ul> <li>getting to know a numerical simulation environment for hydraulic systems</li> </ul>		
	transformation of a task into a simulation model		
	<ul> <li>simulation of common components</li> <li>variation of simulation parameters</li> </ul>		
	using simulations for system dimensioning and optimisation		
	(partly) self-organised teamwork		
	Bücher		
	DUCHEI		
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011		
	Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006     Marking H. H. Boring K. Tip Fire City and in the Other Action 2008.		
Literature	<ul> <li>Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006</li> <li>Beitz, W., Grote, KH.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktu-</li> </ul>		
	Beilz, W., Grole, KH.: Dubbei - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktur Auflage		



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

Course L1257: Fluidics	se 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: Cabi	n Systems Engineering			
Courses				
Title		Тур	Hrs/wk	СР
· ·	echnology in cabin electronics and avionics (L1557)	Lecture	2	2
	echnology in cabin electronics and avionics (L1558)	Recitation Section (small) Project-/problem-based	1	1
Model-Based Systems Enginee	ring (MBSE) with SysML/UML (L1551)	Learning	3	3
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	- Liectrical Engineering			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	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				
	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 84			
Credit points				
-	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Syst Aircraft Systems Engineering: Specialisation Air Transpo Aircraft Systems Engineering: Specialisation Cabin Syste International Management and Engineering: Specialisati Product Development, Materials and Production: Special	rtation Systems: Elective Colems: Compulsory on II. Aviation Systems: Electisation Product Developmentisation Production: Elective	tive Compulso at: Elective Co Compulsory	•



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



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
	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer a communication technology in electronic systems in the cabin and in aircraft. For the system engineer the stro interaction of software, mechanical and electronic system components nowadays requires a basic understanding cabin electronics and avionics.  The course teaches the basics of design and functionality of computers and data networks. Subsequently it focus
Content	on current principles and applications in integrated modular avionics (IMA), aircraft data communication netwo (ADCN), cabin electronics and cabin networks:  • History of computer and network technology  • Layer model in computer technology  • Computer architectures (PC, IPC, Embedded Systems)
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeich Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen u Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessort Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1551: Model-Base	d 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	<ul> <li>Skript zur Vorlesung</li> <li>Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008</li> <li>Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering &amp; Tech, 2011</li> </ul>



Module M0511: Elect	tricity Generation from Wind and Hydro	o Power			
Courses					
Title		Тур	Hrs/wk	СР	
Renewable Energy Projects in I	Emerged Markets (L0014)	Project Seminar	1	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)	novo (L0012)	Lecture	2 1	3	
Wind Energy Use - Focus Offsl	, ,	Lecture	'	'	
Module Responsible	<u> </u>				
Admission Requirements					
	Module: Technical Thermodynamics I,				
	Module: Technical Thermodynamics II,				
Knowledge	Module: Fundamentals of Fluid Mechanics				
-	After taking part successfully, students have reached	I the following learning resu	Ilts		
Professional Competence	! !				
	By ending this module students can explain in det energy use in offshore conditions and can critical co	_	•		
	Furthermore, they are able to describe fundamenta	•		· ·	
	reproduce and explain the basic procedure in the im	-	-	-	
Knowledge	Europe.				
	Through active discussions of various topics within the seminar of the module, students improve their unders and the application of the theoretical background and are thus able to transfer what they have learned in pra				
	Ctudents are able to apply the applying the avetice	l faundations on average		over eveteme and	
	Students are able to apply the acquired theoretical evaluate and assess technically the resulting relations.				
Skills	energy systems. They can in compare critically the	-	_	•	
Onno	1, -	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 Compotones	Students can discuss scientific tasks subjet-specific	ly and multidisciplinary with	in a seminar.	j	
Social Competence				ļ	
Autonomy	Students can independently exploit sources in the			terial to clear the	
Autonomy	contents of the lecture and to acquire the particular k	inowledge about the subjec	tarea.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70			
Credit points	6				
Examination	Written exam				
Examination duration and scale	3 hours written exam				
	Civil Engineering: Specialisation Structural Enginee				
	Civil Engineering: Specialisation Geotechnical Engi	•	ry		
	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. Energy and Environmental Engineering: Elective				
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				
	Renewable Energies: Core qualification: Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory  Water and Environmental Engineering: Specialisation Environment: Compulsory				
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory				



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



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

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



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



Module M0630: Robo	otics and Navigation in Medicine			
Courses				
Title		Тур	Hrs/wk	СР
Robotics and Navigation in Med	licine (L0335)	Lecture	2	3
Robotics and Navigation in Med		Project Seminar	2	2
Robotics and Navigation in Med	licine (L0336)	Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>principles of programming e.g. in Java or C-</li> </ul>	· •		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in details. Systems can be evaluated with respect to collision detection and safety and regulations Students can assess typical systems regarding design and limitations.			
Skills	The students are able to design and evaluate navigation systems and robotic systems for medical applications.			
Personal Competence				
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into thei			
Autonomy	The students can reflect their knowledge and docun appropriate manner.	nent the results of their work. T	hey can preser	nt the results in a
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 minutes			
-	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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory			mpulsory mpulsory Isory pulsory pmpulsory



Course L0335: Robotics an	d Navigation in Medicine
Тур	Lecture
Hrs/wk	2
СР	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	rrse L0338: Robotics and Navigation in Medicine		
Тур	Project Seminar		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Alexander Schlaefer		
Language	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	
СР	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	



Courses				
Title		Тур	Hrs/wk	СР
Supply Chain Management (L12:	18)	Project-/problem-bas		4
Value-Adding Networks (L1190)	,	Learning Lecture	2	2
1	Dorf The other Division	Lecture	2	2
	Prof. Thorsten Blecker			
Admission Requirements	110			
Recommended Previous Knowledge	no			
Educational Objectives	After taking part successfully, studen	ts have reached the following learning i	results	
Knowledge	globalization and emerging markets  Theoretical Approaches and metho  to identify fields of decision in SCM  reasons for the formation of netw theory, principal-agent theory, prope Selected approaches to explain the to illustrate phases of network form to understand the functional mecha to explain and categorize relationsl to categorize sourcing concepts an advantages and disadvantages of terms  to state criteria/ factors/ parameter costs).  to explain methods for location find to interpret phenotypes of production recognize relationships between R to solve sub-problems with the co use of appropriate approaches.	orks based on various theories from in erty-right theory) and the resource-based e development of networks. ation. anisms of inter-organizational and intern hips within networks. d explain motives/barriers or advantage of offshoring and outsourcing and to ill s that influence production location dec	ement and use in pra- nstitutional economic d view.  ational network relatives and disadvantages ustrate the distinction cisions at the global and to describe cohe ution and spare part	ctice. cs (transaction coonships. s. n between the two level (total netwo
Skills	to asses trends and challenges consequences for companies.     to evaluate, anaylse and systematice to anaylse partners and their suitable to select sourcing concepts for speand disadvantages of each approace to evaluate location decisions for peto recognize relationships between of specific models for different situatice to transfer the analyzed concepts to analyse and evaluate the production analyse concepts of Information to design subcontracting, procurement oplan reorganise efficient and flow	roduction and R & D based on concepts n R & D and production as well as their lons. o international practices. of development processes. and communication management in loguent, production and disposal as well as	d on the lecture.  Ind cooperative relative as the cooperative and the cooperative and the cooperative as th	ons. well as advantage luate the suitabili
Personal Competence				
Social Competence	to evaluate intercultural and international relationships based on discussed case studies.  advance planning and design of network formation and their objectives based on content discussed in the lecture definition of procurement strategies for individual parts using the gained knowledge of procurement networks.  design of the procurement network (external/internal/modules etc.) based on the sourcing concepts and corcompetencies, as well as on the findings of the case studies.  to make decision of location for production taking into account global contexts, evaluation methods an buying/selling markets, which were also discussed in the case studies and their dependence on R & D.  Decision on R & D locations based on the insights gained from case studies / practical examples and the selection of an appropriate model.			
	After completing the module stud Management and transfer the acquire	ents are capable to work independered knowledge to new problems.	ently on the subject	of Supply Cha
Workload in Hours	Independent Study Time 110, Study	Time in Lecture 70		
Credit points				
0.00m po				
Examination	Written exam			



## Assignment for the Following Curricula

International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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 L1218: Supply Chai	in 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	<ul> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul>
Literature	Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin.  Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 <sup>rd</sup> 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/l/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-Addin	ng Networks		
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Thorsten Blecker		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>		
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmenstzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>		



Module M0764: Aircr	raft Systems II			
•				
Courses		T	Hara tarda	0.0
<b>Title</b> Aircraft Systems II (L0736)		<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
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	ed the following learning results		
Professional Competence				
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  Students are able to			
Skills	<ul> <li>size primary flight control actuation systems</li> <li>perform a controller design process for the flight control actuators</li> <li>design high-lift kinematics</li> <li>design and analyse landing gear systems</li> <li>design anti-ice systems</li> </ul>			
Personal Competence				-
	Students are able to:			
Social Competence	Develop joint solutions in mixed teams			
Autonomy	Students are able to:  • derive requirements and perform appropriate complex issues and circumstances in a se		esses for airc	raft systems from
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points	<u>.                                    </u>			
	Written exam			
Examination duration and scale	L165 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: (International Management and Engineering: Spec Product Development, Materials and Production: Product Development Materials and Production:	cialisation II. Aviation Systems: Ele Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective ( on Aircraft Systems Engineering: E	ent: Elective Co Compulsory Compulsory Elective Compu	ompulsory



Course L0736: Aircraft Sys	tems 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	<ul> <li>Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems)</li> <li>Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems)</li> <li>Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems)</li> <li>Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>Curry: Aircraft Landing Gear Design: Principles and Practices</li> </ul>

Course L0740: Aircraft Sys	ourse 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: Medi	cal Imaging Systems			
Courses				
Title		Тур	Hrs/wk	СР
Medical Imaging Systems (L081	9)	Lecture	4	6
Module Responsible	Dr. Michael Grass			
Admission Requirements	none			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students h	nave reached the following learning resu	ults	
Professional Competence				ļ
Knowledge	<ul> <li>Explain how the system compon</li> <li>Explain and apply the physical physical equations;</li> <li>Name and describe the physical</li> <li>Explain how spatial and temp generated;</li> </ul>	on and components of the main clinical is ents and the overall system of the imaginal processes that make imaging possion of effects required to generate image contoral resolution can be influenced and tion methods are used to generate imaguses of the different systems.	ing systems function tible and use with trasts; d how to charact	the fundamental
Skills	<ul> <li>Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required;</li> <li>Calculate the parameters of imaging systems using the mathematical or physical equations;</li> </ul>			
Personal Competence				İ
Social Competence	none			į
Autonomy	Understand which physical effective Decide independently for which	ots are used in medical imaging; clinical issue a measuring system can b	pe used.	
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Electrical Engineering: Specialisation M Biomedical Engineering: Core qualificat Product Development, Materials and Pro Product Development, Materials and Pro Product Development, Materials and Pro Theoretical Mechanical Engineering: Sp Theoretical Mechanical Engineering: Te	tion: Compulsory oduction: Specialisation Product Develo oduction: Specialisation Production: Ele oduction: Specialisation Materials: Elect pecialisation Bio- and Medical Technolo	opment: Elective Conctive Compulsory tive Compulsory gy: Elective Comp	,



Course L0819: Medical Image	ging 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	
	Primary book:  1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press  Secondary books:  - A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003.  - W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002.  - H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995.  - O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.



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

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Project-/problem-based	3	3
		Learning Lecture	2	3
Ergonomics (L0653) Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Composites (L0513)		Lecture	2	3
Elements of Integrated Producti		Project-/problem-based	2	3
Elements of integrated Froducti	on Systems (L0921)	Learning	2	3
•	ed Product Development (L1703)	Seminar	2	2
Development Management for M	,	Lecture	2	3
• .	oilistic Approaches in Structural Analysis (L1814)	Seminar	3 2	3 3
Fatigue & Damage Tolerance (L Joining of Polymer-Metal Lightw		Lecture Lecture	2	2
Joining of Polymer-Metal Lightw		Practical Course	1	1
Design with Polymers and Com		Lecture	2	3
- · · · · · · · · · · · · · · · · · · ·	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Co	urse (I 1258)	Project-/problem-based	3	3
Lightweight Design Fractical Co	uise (L1230)	Learning	3	
	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	plications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2 1	2 1
Aircraft Design I (L0834) Microsystems Technology (L07	(24)	Recitation Section (large) Lecture	2	4
		Project-/problem-based		•
Productivity Management (L092	(8)	Learning	2	2
Productivity Management (L093	11)	Recitation Section (small)	1	1
Feedback Control in Medical Te	echnology (L0664)	Lecture	2	3
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpo	rtation (L0855)	Lecture	3	3
Technical Design (L1513) Ceramics Technology (L0379)		Lecture	2	3 3
Materials Testing (L0949)		Lecture Lecture	2	2
Reliability in Engineering Dynam	ics (L0176)	Lecture	2	2
Reliability in Engineering Dynam		Recitation Section (small)	1	2
Reliability of Aircraft Systems (L		Lecture	2	3
Module Responsible	Prof Dieter Krause			
module responsible	Only one of the modules "Selected Topics of Product	Dovolonment Materials Scie	and Prod	uction (Alternative
Admission Requirements	A: 12 LP)" or "Selected Topics of Product Development be selected.	•		•
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence		· · · · · · · · · · · · · · · · · · ·		
Knowledge	Students are able to express their extended knowledge and discuss the connection of different special fields			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence Social Competence				
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	12			
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			ompulsory	



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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	<ul> <li>- Microstructure and properties of the matrix and reinforcing materials and their interaction</li> <li>- Development of composite materials</li> <li>- Mechanical and physical properties</li> <li>- Mechanics of Composite Materials</li> <li>- Laminate theory</li> <li>- Test methods</li> <li>- Non destructive testing</li> <li>- Failure mechanisms</li> <li>- Theoretical models for the prediction of properties</li> <li>- Application</li> </ul>
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of	Integrated Production Systems
Тур	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	190 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	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason  Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development  Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated  Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Тур	Lecture
Hrs/wk	
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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung de Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerech anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ica 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

Course L0310: Fatigue & Damage Tolerance	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	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



polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theorand practical lectures:  Theoretical Lectures:  Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in June Technology  Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  Mechanical Fastening of Polymer-Metal Hybrid Structures  Adhesive Bonding of Polymer-Metal Hybrid Structures  Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures  Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipiteling, Friction Spot Joining and Injection Clinching Joining)  Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:	Course L0500: Joining of Po	plymer-Metal Lightweight Structures
Workload in Notes Independent Study Time 32, Study Time in Lecture 28  Examination form  Klausur  Examination duration and scale  Lecturer Prof. Sergio de Traglia Amancio Filho  Language  Cycle  WiSe  Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technology polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  Theoretical Lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Julicotion to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  - Mechanical Fastening of Polymer-Metal Hybrid Structures  - Adhesive Bonding of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipering, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal lightweight structures as well as their application fields.  **Lecture Notes and selected papers**  - J. Eccutive Notes and selected papers*  - J. Fischiesford, Introduction to materials science for engineers, Prentice-Hall International  - J. Florheisers, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Тур	Lecture
Examination Form   Idausur   Examination Auration and scale   Lecturer   Prof. Sergio de Tragila Amancio Filho   Language   EN   Gyote   Wise   Recommended Previous Knowledge:   Fundamentals of Materials Science and Engineering   Basic Knowledge of Science and Technology of Welding and Joining   Contents:   The lecture and the related laboratory exercises intend to provide an insight on advanced joining technology polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures: Theoretical Lectures:   Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in July Individual on the Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics   Adhesive Bonding of Polymer-Metal Hybrid Structures   Adhesive Bonding of Polymer-Metal Hybrid Structures   Adhesive Bonding of Polymer-Metal Hybrid Structures   - Hybrid Jaining Methods and Direct Assembly of Polymer-Metal Hybrid Structures   - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining)   - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal lightweight structures as well as their application fields.    Lecture Notes and selected papers    - J. Shotheiser, Joining of Polymer-Metal Structures    - J. Shotheiser, Joining of Polymer as well as their application fields.	Hrs/wk	2
Examination duration and scale  Lecturer Prof. Sergio de Traglia Amancio Filho  Language EN  Cycle WSe  Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technology of polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Ju Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Filber Reinforced Plastics - Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz Zentrum Geesthaeth as a 2-3 days compact course) - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (F. Riveting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal lightweight structures as well as their application fields.  • Lecture Notes and selected papers • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International • J. Brotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	СР	2
Examination duration and scaled  Lecture*  Prof. Sergio de Traglia Amancio Filho  Language  Nice  Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technology polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in June Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics - Mechanical Fastening of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipeting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints - Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and jof polymer-metal lightweight structures as well as their application fields.  • Lecture Notes and selected papers • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International • J. Rotheliest-Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer   Prof. Sergio de Traglia Amancio Filho   Language   EN   Cycle   WiSe   Recommended Previous Knowledge:   Fundamentals of Materials Science and Engineering   Basic Knowledge of Science and Technology of Welding and Joining   Contents:   The lecture and the related laboratory exercises intend to provide an insight on advanced joining technology polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures: Theoretical Lectures: - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Jo Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics - Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course) - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints - Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and jo f polymer-metal lightweight structures as well as their application fields.  • Lecture Notes and selected papers • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International • J. Bothelsery, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		
Cycle Wise  Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologic polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  Theoretical Lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Jointroduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  - Mechanical Fastening of Polymer-Metal Hybrid Structures  - Hybrid Joining Protesses of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (F Riveting, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and jof polymer-metal lightweight structures as well as their application fields.  • Lecture Notes and selected papers  • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Examination duration and scale	90 Minuten
Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technological polymer-metal lightweight structures used in engineering applications. A general understanding of the principative consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  Theoretical Lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Jutechnology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  - Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course) - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and joints  Learning Outcomes:  * Lecture Notes and selected papers  * J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  * J.F. Chiesser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Lecturer	Prof. Sergio de Traglia Amancio Filho
Recommended Previous Knowledge: Fundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologic polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical Lectures:  Theoretical Lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in June Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics - Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filtweing, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and joi polymer-metal lightweight structures as well as their application fields.  • Lecture Notes and selected papers • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Language	EN
Eundamentals of Materials Science and Engineering Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technological polymer-metal lightweight structures used in engineering applications. A general understanding of the principate consolidated and new technologies and its main fields of applications is to be accomplished through theorand practical lectures:  Theoretical Lectures:  - Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joint Technology  - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  - Mechanical Fastening of Polymer-Metal Hybrid Structures  - Adhesive Bonding of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join of polymer-metal lightweight structures as well as their application fields.   • Lecture Notes and selected papers  • J.F. Shackelord, Introduction to materials science for engineers, Prentice-Hall International  • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		
Basic Knowledge of Science and Technology of Welding and Joining  Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologic polymer-metal lightweight structures used in engineering applications. A general understanding of the principate consolidated and new technologies and its main fields of applications is to be accomplished through theorand practical lectures:  Theoretical Lectures:  Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joint Technology  Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  Mechanical Fastening of Polymer-Metal Hybrid Structures  - Adhesive Bonding of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymerioints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join polymer-metal lightweight structures as well as their application fields.   • Lecture Notes and selected papers  • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  • J. F. Shackelford, Introduction to materials science for engineers, Hanser Publishers		Recommended Previous Knowledge:
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polymer-metal lightweight structures used in engineering applications. A general understanding of the princip the consolidated and new technologies and its main fields of applications is to be accomplished through theo and practical lectures:  Theoretical Lectures:  Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Journal Technology  Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  Mechanical Fastening of Polymer-Metal Hybrid Structures  Adhesive Bonding of Polymer-Metal Hybrid Structures  Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures  Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipeting, Friction Spot Joining and Injection Clinching Joining)  Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and jof polymer-metal lightweight structures as well as their application fields.  Lecture Notes and selected papers  J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  J.F. Shackelford, Introduction to materials science for designers and engineers, Hanser Publishers		Contents:
- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Journal Technology - Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics - Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course) - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipeting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join polymer-metal lightweight structures as well as their application fields.   • Lecture Notes and selected papers • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles the consolidated and new technologies and its main fields of applications is to be accomplished through theoretic and practical lectures:
Technology Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics  Mechanical Fastening of Polymer-Metal Hybrid Structures  - Adhesive Bonding of Polymer-Metal Hybrid Structures  - Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipeting, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join polymer-metal lightweight structures as well as their application fields.   • Lecture Notes and selected papers  • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		Theoretical Lectures:
- Mechanical Fastening of Polymer-Metal Hybrid Structures - Adhesive Bonding of Polymer-Metal Hybrid Structures - Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course) - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filipeting, Friction Spot Joining and Injection Clinching Joining) - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join for polymer-metal lightweight structures as well as their application fields.   Lecture Notes and selected papers J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joinin Technology
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- Adhesive Bonding of Polymer-Metal Hybrid Structures  - Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures  - Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)  - Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Filiveting, Friction Spot Joining and Injection Clinching Joining)  - Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-joints  Learning Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and join of polymer-metal lightweight structures as well as their application fields.   • Lecture Notes and selected papers  • J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International  • J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers	Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
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Lecture Notes and selected papers     J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International     J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers		Learning Outcomes:
<ul> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> </ul>		After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
<ul> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limite</li> </ul>	Literature	<ul> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



Course L1514: Lightweight	Construction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	
	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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition.</li> </ul>
Literature	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London,</li> </ul>
	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.



	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Recitation Section (large)
Hrs/wk	
СР	
	Independent Study Time 16, Study Time in Lecture 14
	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineerin 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 resultan 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-W 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; Exatranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffner requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
	current edition.  • Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond-current edition.
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



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

Course L0950: Mechanism	s, 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	190 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Des	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	L120 Minuten	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	WiSe	
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation	
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"	



Course L0834: Aircraft Design I	
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	1 12() 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: Microsyster	ns Technology
Tvp	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
-	Mündliche Prüfung
Examination duration and	
scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: (magnetic sensors) (galvanomagnetic sensors)</li> <li>Merchanical Sensors (fremmal gas sensors: sellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor,</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0664: Feedback Control in Medical Technology		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Ulf Pilz, Prof. Olaf Simanski	
Language	DE	
Cycle	SoSe	
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.	
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	
	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



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

0	
Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical Design		
	Lecture	
Hrs/wk		
CP		
	Independent Study Time 62, Study Time in Lecture 28 Schriftliche Ausarbeitung	
Examination duration and		
scale	I (Hausarbeit)	
	Prof. Werner Granzeier	
Language		
Cycle	SoSe	
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>	
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	
	[00]	



**DRAWING** 

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH

Ocument 10070: Ocumentary Technology			
Course L0379: Ceramics Technology  Typ Lecture			
Hrs/wk			
CP			
	Independent Study Time 62,	Study Time in Lecture 28	
Examination Form	Klausur		
Examination duration and scale	190 Minuten		
Lecturer	Dr. Rolf Janßen		
Language	DE/EN		
Cycle	WiSe		
	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.		
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
_		3. Powder fabrication	
Content		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	o Ceramics", John Wiley & Sons, New York, 1975	
	ASM Engineering Materials I	Handbook Vol.4 "Ceramics and Glasses", 1991	
Literature	D.W. Richerson, "Modern Ce	eramic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Materials Te	sting
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
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
	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	
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	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	f Aircraft Systems	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>	
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>	



Module M1143: Mechanical Design Methodology				
Module WT 143. Weci	iamical Design Methodology			
Courses				
Title		Тур	Hrs/wk	СР
Mechanical Design Methodolog	y (L1523)	Lecture	3	4
Mechanical Design Methodolog	y (L1524)	Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	none			
Recommended Previous				
Knowledge				
	After taking part successfully, students hav	re reached the following learning results		
Professional Competence				
Knowledge	Science-based working on product design	considering targeted application of speci	fic product de	sign 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				İ
Social Competence				İ
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory  Mechatronics: Specialisation System Design: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

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



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



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Module M1144: Manu	ıfacturing with Polymers and Con	nposites - From Molecule t	o Part	
Courses				
Title  Manufacturing with Polymers ar	nd Composites (L0511)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3
From Molecule to Composites F	Part (L1516)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements				
Recommended Previous	Structure and Properties of Polymers			
Knowledge	Structure and Properties of Composites			
Educational Objectives	After taking part successfully, students have re	eached the following learning results	1	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes polymers and composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practica problems. They identify and overcome typical problems during the realization of projects in the context of civil engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to give problems in the context of civil engineering. They are able to effectively present and explain their results alone or groups in front of a qualified audience. Students have the ability to develop alternative approaches to a engineering problem independently or in groups and discuss advantages as well as drawbacks.		results alone or in	
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.		s provided by the	
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	1,5 h			
Assignment for the Following Curricula	Product Development, Materials and Production, Specialisation Product Development, Elective Compulsory			

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



Course L1516: From Moleci	ule 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 M1145: Auto	mation and Simulation			
Courses				
Title		Тур	Hrs/wk	СР
Automation and Simulation (L15 Automation and Simulation (L15		Lecture Recitation Section (large)	3	3
Module Responsible	Prof. Günter Ackermann			
Admission Requirements	none			
Recommended Previous Knowledge	BSc Mechanical Engineering or similar			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
	Students can describe the structure an the function transfer via bus systems an programmable logic co	·	esponding con	nponents, the data
Knowledge	They can describe the basich principle of a numeri	c simulation and the correspondi	ng parameters	i.
Midwieuge	Thy can explain the usual method to simulate the d	lynamic behaviour of three-phase	e machines.	
	Students can describe and design simple controlle	rs using established methodes.		
	They are able to assess the basic characterisitcs o given plant.	f a given automation system and	to evaluate, if	t is adequate for a
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 machines.	for the caclulation of the dyna	mical behavio	ur of three-phase
Personal Competence				
•	Teamwork in small teams.			
Autonomy	Students are able to identify the need of metho analysisis in an adequate manner und to evaluate	-	utomation sys	tems, to do these
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde			
Assignment for the Following Curricula	Thiernational Management and Engineering, Specialisation it Product Development and Production, Elective			



Course L1525: Automation	and Simulation
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Günter Ackermann
Language	DE
Cycle	SoSe
	Structure of automation systsems
	Aufbau von Automationseinrichtungen
	Structure and function of process computers and corresponding componentes
	Data transfer via bus systems
Content	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	ourse L1527: Automation and Simulation	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Günter Ackermann	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1156: Systo	ems Engineering			
Courses				
Title Systems Engineering (L1547) Systems Engineering (L1548)		Typ Lecture Recitation Section (large)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Licotifical Engineering			
Educational Objectives	After taking part successfully, students have reached 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				i
Social Competence	Students are able to:			
Autonomy	Students are able to:  • interact and communicate in a development team which	n has distributed tasks		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	<u> </u>			
	Written exam			
Examination duration and scale	I 120 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: Compulational Management and Engineering: Specialisat International Management and Engineering: Specialisation Compulsory	ion II. Aviation Systems: Election III. Product Developments ompulsory botics: Elective Compulsory lisation Product Developments on Production: Elective	nent and Pront nt: Compulsor Compulsory	duction: Elective



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

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



Module M1161: Turb	omachinery			
Courses				
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 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 read	ched the following learning results		
Professional Competence				
Knowledge	The students can  distinguish the physical phenomena of cunderstand the different mathematic moderate calculate and evaluate turbomachinery.			
Skills	The students are able to - understand the physics of Turbomachinery, - solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to  • discuss in small groups and develop an	approach.		
Autonomy	The students are able to  develop a complex problem self-consiste analyse the results in a critical way, have an qualified exchange with other st			
Workload in Hours	Independent Study Time 124, Study Time in Lec	eture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems Energy Systems: Specialisation Marine Enginee Product Development, Materials and Production Product Development, Materials and Production Product Development, Materials and Production	ering: Elective Compulsory i: Specialisation Product Developme i: Specialisation Production: Elective	e Compulsory	ompulsory



Course L1562: Turbomachi	nes
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Franz Joos
Language	DE
Cycle	SoSe
Content	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	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>

Course L1563: Turbomachi	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: Phen	omena and Methods in Materials	s Science		
Courses				
Title		Тур	Hrs/wk	СР
Experimental Methods for the C Phase equilibria and transforma	haracterization of Materials (L1580)	Lecture Lecture	2 2	3
	, ,	Lecture	2	3
Module Responsible				
Admission Requirements	none.			
Recommended Previous Knowledge	Fundamentals of Materials Science (I and II)			
Educational Objectives	After taking part successfully, students have	reached the following learning re	esults	
Professional Competence				
Knowledge	The students will be able to explain the prop in particular metallic, ceramic, polymeri 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	specialists and to develop ideas	s further.	
Social Competence				
	The students are able to			
Autonomy	<ul><li>assess their own strengths and weak</li><li>define tasks independently.</li></ul>	rnesses.		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
_	International Management and Engineerin Compulsory Materials Science: Core qualification: Comp Product Development, Materials and Product Development, Materials and Product Development, Materials and Product Development, Materials and Product Theoretical Mechanical Engineering: Special Theoretical Mechanical Engineering: Techn	ulsory ction: Specialisation Product Devo ction: Specialisation Production: E ction: Specialisation Materials: Co alisation Materials Science: Electi	elopment: Elective Co Elective Compulsory ompulsory ive Compulsory	

Course L1580: Experimenta	al 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	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).  William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).



Course L1579: Phase equilibria and transformations	
Тур	Lecture
Hrs/wk	2
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.

Courses



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

Ocurses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Project-/problem-based	3	3
		Learning		
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Composites (L0513)		Lecture	2	3
Elements of Integrated Production Systems (L0927)		Project-/problem-based Learning	2	3
Emotional Design / User Center	red Product Development (L1703)	Seminar	2	2
Development Management for I		Lecture	2	3
	bilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (I		Lecture	2	3
Joining of Polymer-Metal Lightw		Lecture	2	2
Joining of Polymer-Metal Lightw		Practical Course	1	1
Design with Polymers and Com		Lecture	2	3
	ibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
	ibre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
		Project-/problem-based		
Lightweight Design Practical Co	ourse (L1258)	Learning	3	3
Mechanisms. Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap		Lecture	2	3
Aircraft Design I (L0820)	<b></b>	Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	724)	Lecture	2	4
				7
Productivity Management (L092	28)	Project-/problem-based Learning	2	2
Productivity Management (L093	21)	Recitation Section (small)	1	1
		, ,		
Feedback Control in Medical Te	echnology (L0664)	Lecture	2	3
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpo	rtation (L0855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	nics (L0176)	Lecture	2	2
Reliability in Engineering Dynam	nics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L	_0749)	Lecture	2	3
Module Responsible	Prof Dieter Krause			
module responsible		B. d. Maria		-1' /All1'
	Only one of the modules "Selected Topics of Product A: 12 CP)" or "Selected Topics of Product Developm	•		•
Admission Requirements	can be selected.	ieni, materiais ocience and r	TOddclion (Alle	malive b. 6 Cr)
	can be selected.			
Recommended Previous				
Knowledge	INONE			
	After taking part successfully, students have reached t	he following learning results		
-	1	John wing rearring results		
Professional Competence				
	Oli de de ser able la comunitación de de de de	I . d d .P		
War lada	Students are able to express their extended kn	_	inection of diffe	rent special fleids
Knowledge		•		
	Students are qualified to connect different specified.	cial fleids with each other		
	Students can apply specialized solution strate	gies and new scientific method	ds in selected a	reas
Skills	1	•		
Crune	approaches	now and animown problems	and dan dove	nop own coldaer
Personal Competence	İ			
_	! !			
Social Competence	1 - I			
Autonomy	• Studente are able to develop their knowledge	and skills by sutanamous slav	ation of courses	
Autonomy	Students are able to develop their knowledge	and skills by autonomous elec	clion of courses	-
Workload in Hours	Depends on choice of courses			
WOI KIOAU III FIOURS	Depends on onoice of courses			
Credit points	6			
A 1	Product Development, Materials and Production: Spe	cialisation Product Developme	ent: Elective Co	mpulsory
Assignment for the	Product Development, Materials and Production, Spec			·
Following Curricula	Product Development, Materials and Production: Spe			
	·		•	



Course L1592: Applied Auto	omation
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	<ul> <li>- Microstructure and properties of the matrix and reinforcing materials and their interaction</li> <li>- Development of composite materials</li> <li>- Mechanical and physical properties</li> <li>- Mechanics of Composite Materials</li> <li>- Laminate theory</li> <li>- Test methods</li> <li>- Non destructive testing</li> <li>- Failure mechanisms</li> <li>- Theoretical models for the prediction of properties</li> <li>- Application</li> </ul>
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 I 0027: Flaments of	Integrated Production Systems
	Project-/problem-based Learning
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 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	
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason  Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development  Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated  Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Developmen	nt 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ICA 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	
Cycle	
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Comon	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



	Construction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
xamination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineer 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resulta 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-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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffn 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
Literature	<ul> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Y current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond</li> </ul>
	<ul> <li>current edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Recitation Section (large)
Hrs/wk	
СР	
	Independent Study Time 16, Study Time in Lecture 14
	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineerin 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 resultan 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-W 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; Exatranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffner 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
Literature	<ul> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Yocurrent edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



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

Course L0950: Mechanisms	s, 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

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



Course L0834: Aircraft Design I	
Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressurn sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomapnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas sensor, capacitive; processed pro</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

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



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

Oniman I 1100, Cir. Cimma		
Course L1130: Six Sigma		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	190 Minuten	
Lecturer	Prof. Claus Emmelmann	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>	
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008	



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

Course L1513: Technical Design		
	Lecture	
Hrs/wk		
CP		
	Independent Study Time 62, Study Time in Lecture 28	
Examination Form  Examination duration and	Schriftliche Ausarbeitung	
scale	I (Hausarbeit)	
Lecturer	Prof. Werner Granzeier	
Language		
Cycle	SoSe	
Content	Basics with analysis, concept, proposal drawings and sketches Samples from practice of technical industrial design Product concept with new ideas and package ID proposal with structural concept and external product ergonomics Visualisation and presentation of the overall concept Realization as individual case studies	
	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	
	[440]	



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH

Course L0379: Ceramics T	-	
	Lecture	
Hrs/wk	<u> </u>	
СР	ļ-	
	Independent Study Time 62,	Study Time in Lecture 28
Examination Form	1	
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
Content		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	o Ceramics", John Wiley & Sons, New York, 1975
	ASM Engineering Materials	Handbook Vol.4 "Ceramics and Glasses", 1991
Literature	D.W. Richerson, "Modern Ce	eramic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung	

Course L0949: Materials Te	sting	
	Lecture	
Hrs/wk		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
Examination Form		
Examination duration and	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	
	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	190 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
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	
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	f 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	190 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



Module M1226: Mechanical Properties				
Courses				
Title		Тур	Hrs/wk	СР
Mechanical Behaviour of Brittle	Materials (L1661)	Lecture	2	3
Dislocation Theory of Plasticity	(L1662)	Lecture	2	3
Module Responsible	Dr. Erica Lilleodden			
Admission Requirements	none			
Recommended Previous Knowledge	Basics in Materials Science I/II			
Educational Objectives	After taking part successfully, students hav	re reached the following learning re	sults	
Professional Competence				
Knowledge	Students can explain basic principles of cr (energy minimization, energy barriers, ent		igrams, tractions) and	d thermodynamics
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 weaknes	ses		
Autonomy	- assess their own state of learning in specific terms and to define further work steps on this basis guided teachers.		basis guided by	
	- work independently based on lectures needed	and notes to solve problems, and	to ask for help or c	larifications when
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula	Materials Science: Core qualification: Com Mechanical Engineering and Managemen Product Development, Materials and Prod Product Development, Materials and Prod Product Development, Materials and Prod	t: Specialisation Materials: Elective uction: Specialisation Product Deve uction: Specialisation Production: E	elopment: Elective Co	ompulsory



Course L1661: Mechanical	Behaviour of Brittle Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider
Language	DE/EN
Cycle	SoSe
	Theoretical Strength Of a perfect crystalline material, theoretical critical shear stress  Real strength of brittle materials Energy release reate, stress intensity factor, fracture criterion
	Scattering of strength of brittle materials Defect distribution, strength distribution, Weibull distribution Heterogeneous materials I
	Internal stresses, micro cracks, weight function,  Heterogeneous materials II  Toughening mechanisms: crack bridging, fibres
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	
	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	
Content	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	
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	



Courses				
Courses		T	I lue fode	OD
Title Optimal and Robust Control (LC	658)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Optimal and Robust Control (LC		Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner	· · ·		
Admission Requirements	Control Systems Theory and Design			
Recommended Previous Knowledge	<ul> <li>Classical control (frequency response, root locus)</li> <li>State space methods</li> <li>Linear algebra, singular value decomposition</li> </ul>			
Educational Objectives	After taking part successfully, students have react	ned the following learning results		
Professional Competence		-		
Knowledge	<ul> <li>Students can explain the significance of the They can explain the duality between option of They can explain how the H2 and H-constraints.</li> <li>They can explain how an LQG design promote They can explain how model uncertainty design</li> <li>They can explain how - based on the superformance for an uncertain plant.</li> <li>They understand how analysis and synthmatrix inequalities.</li> </ul>	mal state feedback and optimal state feedback and optimal state infinity norms are used to represented as special or can be represented in a way that all gain theorem - a robust control	te estimation. sent stability case of an H2 t lends itself to	and performand design problem probust controlle intee stability an
Skills	<ul> <li>Students are capable of designing and tuning LQG controllers for multivariable plant models.</li> <li>They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it.</li> <li>They are capable of translating time and frequency domain specifications for control loops into constraint on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design.</li> <li>They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing mixed-objective robust controller.</li> <li>They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them.</li> <li>They can carry out all of the above using standard software tools (Matlab robust control toolbox).</li> </ul>			
Personal Competence				
•	Students can work in small groups on specific pro	blems to arrive at joint solutions.		
•	Students are able to find required information in s	ources provided (lecture notes, lite	rature, softwar	e documentation
Autonomy	and use it to solve given problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Oral exam			
Examination duration and	30 min			
scale	Computer Science: Specialisation Intelligence Er			
Assignment for the Following Curricula	I Diamadical Engineering, Chasialisation Implants and Endangathasas, Flactive Compulsor,			



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

Course L0659: Optimal and Robust Control	
Тур	Recitation Section (small)
Hrs/wk	2
СР	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 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
		Learning		
Ergonomics (L0653) Structure and Proporties of Polymore (L0290)		Lecture	2	3
Structure and Properties of Composites (L0389) Structure and Properties of Composites (L0513)		Lecture Lecture	2 2	3 3
Structure and Properties of Composites (L0513)		Project-/problem-based		-
Elements of Integrated Production	on Systems (L0927)	Learning	2	3
Emotional Design / User Center	ed Product Development (L1703)	Seminar	2	2
Development Management for M	Mechatronics (L1512)	Lecture	2	3
= :	pilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (L		Lecture	2	3
Joining of Polymer-Metal Lightw		Lecture	2	2
Joining of Polymer-Metal Lightw Design with Polymers and Com		Practical Course Lecture	1 2	1 3
= :	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
		Project-/problem-based		
Lightweight Design Practical Co	urse (L1258)	Learning	3	3
Mechanisms, Systems and Pro-	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	plications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	(24)	Lecture	2	4
Productivity Management (L092	28)	Project-/problem-based	2	2
Productivity Management (L093		Learning  Recitation Section (small)	1	1
Feedback Control in Medical Te	•	Recitation Section (small) Lecture	2	3
Renewable Energy (L0313)	critiology (£0004)	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpor	rtation (L0855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	ics (L0176)	Lecture	2	2
Reliability in Engineering Dynam	ics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L	.0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements				
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
<b>Professional Competence</b>				
Knowledge	<ul> <li>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</li> <li>Students are qualified to connect different special fields with each other</li> </ul>			
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	nce			
Social Competence	i i			
Autonomy				es.
Workload in Hours	Depends on choice of courses			
Credit points				
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				



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		
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of Integrated Production Systems		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
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	
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason  Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development  Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated  Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Developmen	nt 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ICA 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	EN
Cycle	WiSe
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	190 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	DE	
Cycle	WiSe	
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples	
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Mündliche Prüfung
Examination duration and	<u> </u>
scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineeri 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 resultar Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties
Content	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-V 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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffner 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et gyropt edition.</li> </ul>
Literature	<ul> <li>current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Yocurrent edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond.</li> </ul>
	current edition.  Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition



qvT	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
xamination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
	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; Engineer 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 lag
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resulta Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties
Content	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffer 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Y current edition.</li> </ul>
	<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> </ul>



Course L1258: Lightweight	Design Practical Course
3 5	Project-/problem-based Learning
Hrs/wk	
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	Pevelopment 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	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

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



Course L0834: Aircraft Design I		
Тур	Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometery</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process;</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pelistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas sensor, part particular probe, MOSFET gas sensor; per per particular probe, MOSFET gas sensor; per p</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

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



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

Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical Design	
	Lecture
Hrs/wk	
CP	
	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
scale	(Hausarbeit)
	Prof. Werner Granzeier
Language	
Cycle	
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
	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
	rio T



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH

Course L0379: Ceramics T	1	
	Lecture	
Hrs/wk	<u> </u>	
СР	ļ <u></u>	
	Independent Study Time 62,	Study Time in Lecture 28
Examination Form		
Examination duration and scale	90 Minuten	
	Dr. Rolf Janßen	
Language	DE/EN	
Cycle	WiSe	
	on powder-based processin Also, some aspects of glass of ceramics and ceramic co	essing with emphasis on advanced structural ceramics. The course focus predominatly ig, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). and cement science as well as new developments in powderless forming techniques mposites will be addressed Examples will be discussed in order to give engineering if technology development and specific applications of ceramic components.
	Content:	1. Introduction
	Inhalt:	2. Raw materials
Content		3. Powder fabrication
Content		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	o Ceramics", John Wiley & Sons, New York, 1975
Literature	ASM Engineering Materials	Handbook Vol.4 "Ceramics and Glasses", 1991
	D.W. Richerson, "Modern Ce	eramic Engineering", Marcel Decker, New York, 1992
	Skript zur Vorlesung	

Course L0949: Materials Te	sting
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	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
	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		
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	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	f 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	190 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



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

Courses				
Title		Тур	Hrs/wk	СР
Applied Automation (L1500)		Project-/problem-based	3	3
Applied Automation (L1592)		Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Con	nposites (L0513)	Lecture	2	3
Elements of Integrated Production	on Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Center	ed Product Development (L1703)	Seminar	2	2
Development Management for M	Mechatronics (L1512)	Lecture	2	3
Design Optimization and Probab	pilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (L	.0310)	Lecture	2	3
Joining of Polymer-Metal Lightw	eight Structures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightw	eight Structures (L0501)	Practical Course	1	1
Design with Polymers and Com	posites (L0057)	Lecture	2	3
Lightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Co	urse (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	plications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	24)	Lecture	2	4
Productivity Management (L092	8)	Project-/problem-based Learning	2	2
Productivity Management (L093	1)	Recitation Section (small)	1	1
Feedback Control in Medical Te	•	Lecture	2	3
Renewable Energy (L0313)	Chilology (L0004)	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpor	rtation (L0855)	Lecture	3	3
Technical Design (L1513)	(2000)	Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	ics (L0176)	Lecture	2	2
Reliability in Engineering Dynam		Recitation Section (small)	1	2
Reliability of Aircraft Systems (L		Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence		0 0		
Knowledge	<ul> <li>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</li> <li>Students are qualified to connect different special fields with each other</li> </ul>			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence				
Social Competence	-			
Autonomy	Students are able to develop their knowledge	and skills by autonomous ele	ction of course	es.
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			



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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Dr. Hans Wittich	
Language	DE	
Cycle	WiSe	
Content		
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	



Course L0513: Structure and Properties of Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of	Integrated Production Systems
Тур	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	190 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 D	esign / 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	Lleamarbeit und abschließender Vortrag		
Lecturer	Jörg Heuser		
Language	DE		
Cycle	SoSe		
Content	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason  Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development  Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated  Exemplary Project: Holistic product evaluation, product optimization		
Literature	Wird in der Veranstaltung angegeben		

Course L1512: Development 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	EN
Cycle	WiSe
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineerin 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
Content	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultan Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties
	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-W 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; Exatranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffner equirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
•••	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et a current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
Literature	current edition.  • Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond-current edition.
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



Typ	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
xamination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Enginee 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 lag
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resulta Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties
Content	Strength of Laminated Plates
	Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffn requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into accou
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Y current edition.</li> </ul>
	<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> </ul>



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

Course L0950: Mechanisms	s, 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Design I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	L12() Minuten	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	WiSe	
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation	
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"	



Course L0834: Aircraft Design I		
Typ 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: Microsysten	ns Technology		
Тур	Lecture		
Hrs/wk			
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Examination Form	Mündliche Prüfung		
Examination duration and scale	30 min		
Lecturer	Prof. Hoc Khiem Trieu		
Language	EN		
Cycle	WiSe		
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometery</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process;</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pelistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas sensor, part particular probe, MOSFET gas sensor; per particular probe, MOSFET gas sensor; per parti</li></ul>		
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008		



Course L0928: Productivity	Management		
Тур	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	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		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form		
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 C	ontrol in Medical Technology		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Mündliche Prüfung		
Examination duration and scale			
Lecturer	Ulf Pilz, Prof. Olaf Simanski		
Language	DE		
Cycle	SoSe		
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.		
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart  Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag  M.C.K.Khoo: "Physiological Control System", IEEE Press, 2000		

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



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

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Course L1130: Six Sigma			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	190 Minuten		
Lecturer	Prof. Claus Emmelmann		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>		
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme Perspektiven, 5. Aufl., Wiesbaden 2008		



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

Course L1513: Technical Design			
	Lecture		
Hrs/wk			
CP			
	Independent Study Time 62, Study Time in Lecture 28		
Examination Form  Examination duration and	Schriftliche Ausarbeitung		
scale	I (Hausarbeit)		
	Prof. Werner Granzeier		
Language			
Cycle	SoSe		
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>		
	Literatur über technisches Produktdesign  Technisches Rendering und Präsentation  Zeichnen und perspektivisches Entwerfen  Literaturhinweise		
	What is Product Design?		
	Laura Slack		
	Roto Vision 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		
1	Creative Techniques		
	[157]		



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH Hambure University of Technolog

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

Course L0949: Materials Te	esting		
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	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	
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
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	
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	f Aircraft Systems
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



Module M0563: Robo	otics			
Courses				
Title Robotics: Modelling and Control Robotics: Modelling and Control		Typ Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 3 3
Module Responsible	· · · ·			
Admission Requirements				
	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties robotics.	of robots and solution appro	aches for mu	ultiple problems in
Skills	Students are able to derive and solve equations of motion for various manipulators.  Students can generate trajectories in various coordinate systems.  Students can design linear and partially nonlinear controllers for robotic manipulators.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups.			
Autonomy	Students are able to recognize and improve knowledge deficits independently.  With instructor assistance, students are able to evaluate their own knowledge level and define a further course o study.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	1120 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Production Management: Specialisation Production Technology: 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 Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			



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

Course L1305: Robotics: M	ourse 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: Flight Physics				
Courses				
Title Aerodynamics and Flight Mecha	anics I (L0727)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
Flight Mechanics II (L0730) Flight Mechanics II (L0731)	, ,	Lecture Recitation Section (large)	2 1	2 1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics     Mechanics     Thermodynamics     Aviation			
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
-	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
	Written exam			
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Product Development Materials and Production: Specialisation Production: Elective Compulsory			

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



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

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



Module M0815: Prod	uct Planning			
Courses				
Title		Тур	Hrs/wk	СР
Product Planning (L0851)		Project-/problem-based	3	3
Froduct Flaming (L0001)		Learning	3	3
Product Planning Seminar (L089	53)	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 reached 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 instruments			
Personal Competence				
Social Competence	Interact within a team     Raise awareness for globabl issues			
Autonomy	<ul> <li>Gain access to knowledge sources</li> <li>Interpret complex cases</li> <li>Develop presentation skills</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	Global Innovation Management: Core qualification: Com International Management and Engineering: Specialisati Mechanical Engineering and Management: Specialisatic Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Theoretical Mechanical Engineering: Specialisation Production Mechanical Engineering: Technical Completer	on I. Electives Management: on Management: Elective Co isation Product Developmer isation Production: Elective Co isation Materials: Elective Co duct Development and Product Development and Product Development and Produ	mpulsory  It: Elective Cor  Compulsory  Intion: Elective	npulsory



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	
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	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Cornelius Herstatt	
Language	EN	
Cycle	WiSe	
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independently	
Literature	see/siehe Vorlesung Produktplanung/Product Planning	



Module M0830: Envi	ronmental Protection and Manageme	nt		
Courses				
Title		Тур	Hrs/wk	СР
Integrated Pollution Control (L05		Lecture	2	2
Health, Safety and Environment Health, Safety and Environment		Lecture Recitation Section (small)	2 1	3 1
		necitation Section (Smail)	ı	'
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Good knowledge in Technologies for Enviro</li> <li>Good knowledge of the relevant Environme</li> <li>Basic knowledge of instruments for Environ</li> </ul>	ntal Legislation	e, integrated so	lutions)
Educational Objectives	After taking part successfully, students have reache	d 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 ecoefficiency 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				İ
	The students can work together in international gro	ups.		İ
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 Lecture	e 70		
Credit points				
-	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	I Compilieory			



Course L0502: Integrated Pollution Control		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	The lecture focusses on:  The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip	
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	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>	
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)  Exercises can be downloaded from StudIP	

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



Madala Moocza Buad		and Divital Factoring		
Module MU867: Prod	uction Planning & Control a	and Digital Enterprise		
Courses				
Title		Тур	Hrs/wk	СР
The Digital Enterprise (L0932)		Lecture	2	2
Production Planning and Contro	l (L0929)	Lecture	2	2
Production Planning and Contro	l (L0930)	Recitation Section (small)	1	1
Exercise: The Digital Enterprise	e (L0933)	Recitation Section (small)	1	1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	Leundamentals of Production and Oua	llity Management		
Educational Objectives	After taking part successfully, students	s have reached the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.			
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.			
Personal Competence		, 0		•
Social Competence	Students can develop joint solutions in mixed teams and present them to others.			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
	International Management and Engineering: Specialisation II. Product Development and Production: Electory  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  Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		y mpulsory lsory ompulsory	

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

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

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



Module M0962: Sust	ainability and Risk Manageme	ent		
Courses				
<b>Title</b> Safety, Reliability and Risk Asse Environment and Sustainability	, ,	<b>Typ</b> Seminar Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning res	ults	
Professional Competence				
Knowledge	Students are able to describe single tec as well as environmental and sustainabl  • basics in safety and reliability of t  • safety and reliability analysis met  • risk assessment  • Production and usage of bio-cha  • energy production and supply  • sustainable product design  Students are able apply interdisciplinary	le engineering, in detail: technical facilities thods r		
	They can evaluate the effort and costs fo	r processes and select economically for	easible treatment co	ncepts.
Personal Competence				ļ
Social Competence Autonomy	Students can gain knowledge of the Furthermore, they can define targets fo sustainability concepts accordance with	r new application or research-oriente	d duties in for risk	•
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minute	es in groups)		
<u> </u>	Civil Engineering: Core qualification: Co International Management and Engineer Product Development, Materials and Pro Product Development, Materials and Pro Product Development, Materials and Pro Water and Environmental Engineering: (	ring: Specialisation II. Civil Engineerin oduction: Specialisation Product Devel oduction: Specialisation Production: El oduction: Specialisation Materials: Elec	opment: Elective Co ective Compulsory	•

Course L1145: Safety, Relia	ability and Risk Assessment
Тур	Seminar
Hrs/wk	2
СР	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	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>



Course L0319: Environment and Sustainability		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Kerstin Kuchta	
Language	EN	
Cycle	WiSe	
	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 M1002: Production and Logistics Management				
	3 3			
Courses				
Title		Тур	Hrs/wk	СР
Operative Production and Logis	tics Management (L1198)	Lecture	2	2
Strategic Production and Logisti	ics Management (L1089)	Project-/problem-based Learning	3	4
· · · · · · · · · · · · · · · · · · ·	Prof. Wolfgang Kersten			
Admission Requirements				
i	Introduction to Business and Management			
Recommended Previous Knowledge	The previous knowledge, that is necessary for learning. Log-in and additional information will l	-		accessable via e-
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students will be able  - to differentiate between strategic and operati  - to describe the areas of production and logis  - understand the difference between traditiona  - to describe and explain the actual challeng context.	tics management, I and new concepts of production p	lanning and co	-
Skills	Based on the acquired knowledge students are     Applying methods of production and logistics     Selecting sufficient methods of production ar     Selecting appropriate methods of production     Making a holistic assessment of areas of influence factors.	management in an international co d logistics management to solve pr and logistics management also for	actical problem non-standardiz	zed problems,
Personal Competence				
Social Competence	After completion of the module students can - lead discussions and team sessions,  Social Competence - arrive at work results in groups and document them, - develop joint solutions in mixed teams and present them to others, - present solutions to specialists and develop ideas further.			
	After completion of the module students can			
	- assess possible consequences of their professional activity,			
Autonomy	- define tasks independently, acquire the requis	te knowledge and use suitable me	ans of impleme	ntation,
	- define and carry out research tasks bearing in	mind possible societal consequenc	es.	
Workload in Hours	Independent Study Time 110, Study Time in Led	ture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 min			
Assignment for the Following Curricula	International Management and Engineering: Co Logistics, Infrastructure and Mobility: Core quali Product Development, Materials and Productior Product Development, Materials and Productior Product Development, Materials and Productior	fication: Compulsory : Specialisation Product Developm : Specialisation Production: Electiv	e Compulsory	ompulsory



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



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



Module M1155: Aircr	raft Cabin Systems			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in:  • Mathematics  • Mechanics  • Thermodynamics  • Electrical Engineering  • Control Systems			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to:  • describe cabin operations, equipment in the cabin a  • explain the functional and non-functional requireme  • elucidate the necessity of cabin operating systems a  • assess the challenges human factors integration in	ents for cabin Systems and emergency Systems		
Skills	Students are able to: • design a cabin layout for a given business model of • design cabin systems for safe operations • design emergency systems for safe man-machine in • solve comfort needs and entertainment requiremen	nteraction		
Personal Competence				
Social Competence	Students are able to: • understand existing system solutions and discuss the	neir ideas with experts		
Autonomy	Students are able to: • Reflect the contents of lectures and expert presenta	tions self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 Minutes			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Ele Aircraft Systems Engineering: Core qualification: Cor International Management and Engineering: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Specialisation of Theoretical Mechanical Engineering: Specialisation of Theoretical Mechanical Engineering: Technical Com	npulsory isation II. Aviation Systems: Ele ecialisation Product Developme ecialisation Production: Elective ecialisation Materials: Elective ( Aircraft Systems Engineering: E	ent: Elective Compulsory Compulsory Elective Comp	ompulsory



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

Course L1546: Aircraft Cabin Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
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 M1174: Auto	mation Technology and Systems			
	σ, ,			
Courses				
Title		Тур	Hrs/wk	СР
Handling and Assembly System	ns (L1591)	Lecture	2	2
Handling and Assembly System		Recitation Section (small)	1	1
Automation Technology (L1590 Automation Technology (L1739		Lecture Recitation Section (small)	2 1	2 1
		necitation Section (Smail)	ı	'
•	Prof. Thorsten Schüppstuhl			
Admission Requirements	<u>!</u>			
Knowledge	without major course assessment			
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	know the characteristic components or interaction     know methods for a systematical analysi     have special competences in industrial relations.	s of automation tasks and are able to		rstanding of their
Skills	analyze complex Automation tasks     develop application based concepts and     design subsystems and integrate into on     investigate and evaluate safety of machii     create simple programs for robots and predesign of circuit for pneumatic application	e system nery rogrammable logic controllers		
Personal Competence				
	Students are able to			
Social Competence	- find solutions for automation and handling task		al level and re	oresent decisions.
Autonomy	Students are able to  analyze automation tasks independently generate programs for robots and progradevelop solutions for practice oriented ta design safety concepts for automation ag assess consequences of their profession	ammable logic devices autonomousl sks of automation independently oplications	у	
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Product Development Materials and Production	: Specialisation Production: Compul : Specialisation Materials: Elective C Complementary Course: Elective Co	sory Compulsory ompulsory	



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

Course L1	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 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		
	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	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		



Module M1183: Lase	r systems and methods of	manufacturing design and a	nalysis	
Courses				
Title		Тур	Hrs/wk	СР
Laser Systems and Process Te	, ,	Lecture	2	3
Methods for Analysing Production	on Processes (L0876)	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning r	results	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development, Materials and Product Development, Materials and Theoretical Mechanical Engineering	I Production: Specialisation Product Dev I Production: Specialisation Production: I Production: Specialisation Materials: E I: Specialisation Product Development a I: Technical Complementary Course: Ele	Compulsory lective Compulsory and Production: Elective	, ,

0	To bod of the control
	ms 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	<ul> <li>Fundamentals of laser technology</li> <li>Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers</li> <li>Laser system technology: beam forming, beam guidance systems, beam motion and beam control</li> <li>Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment</li> <li>Quality assurance and economical aspects of laser material processing</li> <li>Markets and Applications of laser technology</li> <li>Student group exercises</li> </ul>
Literature	<ul> <li>Hügel, H., T. Graf: Laser in der Fertigung: Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014.</li> <li>Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010.</li> <li>Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010.</li> <li>J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005.</li> <li>Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011</li> </ul>



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



Module M1342: Poly	mers			
Courses				
Title		Тур	Hrs/wk	СР
Structure and Properties of Poly		Lecture	2	3
Processing and design with poly	ymers (L1892)	Lecture	2	3
Module Responsible	Dr. Hans Wittich			
Admission Requirements				
Recommended Previous Knowledge	I Basics: chemistry / physics / material science			
Educational Objectives	After taking part successfully, students have re	eached the following learning res	sults	
Professional Competence				ļ
	Students can use the knowledge of plastic	s and define the necessary tes	sting and analysis.	
Knowledge	They can explain the complex relationship	s structure-property relationshi	p and	
	the interactions of chemical structure of sustainability, environmental protection). Students are capable of	f the polymers, including to	explain neighboring	g contexts (e.g.
Skills	<ul> <li>using standardized calculation methods in a given context to mechanical properties (modulus, stream) calculate and evaluate the different materials.</li> </ul>			ulus, strength) to
	- For mechanical recycling problems select resistance.	ting appropriate solutions and	sizing example Sti	ffness, corrosion
Personal Competence				ļ
	Students can,			
Social Competence	- arrive at work results in groups and docu	ment them.		
	- provide appropriate feedback and handle Students are able to,	feedback on their own perform	ance constructively	/.
	- assess their own strengths and weaknes	ses		
Autonomy	- assess their own state of learning in spe by teachers.	ecific terms and to define furth	ner work steps on t	his basis guided
	- assess possible consequences of their p	rofessional activity.		
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 18() min			
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Biomedical Engineering: Specialisation Implation Biomedical Engineering: Specialisation Artific Biomedical Engineering: Specialisation Mana Biomedical Engineering: Specialisation Medi Product Development, Materials and Product Product Development, Materials and Product Product Development, Materials and Product Theoretical Mechanical Engineering: Special	unts and Endoprostheses: Complicial Organs and Regenerative Meagement and Business Administrical Technology and Control Thection: Specialisation Production: Eletion: Specialisation Materials: Eletion: Specialisation Product Deve	ulsory edicine: Elective Con ation: Elective Compory: Elective Compul lective Compulsory ctive Compulsory lopment: Elective Co	oulsory 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	
	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	
Literature	Emensiem. Forymer-vverkstolle, Gan 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: Te Regulations)	chnical Complementary Course	e for	PEPMS	(according	to	Subject	Specific
Courses							
Title			Тур		Hrs/	wk C	Р
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 re	eached th	e following l	earning results			
-	see selected module according to FSPO see selected module according to FSPO						
Personal Competence Social Competence Autonomy	I and colouted module according to FCDO						
Workload in Hours	Depends on choice of courses						
Credit points	6					•	
Assignment for the Following Curricula	Product Development, Materials and Producti Product Development, Materials and Producti Product Development, Materials and Producti	on: Speci	ialisation Pro	duction: Elective	Compi	ulsory	Isory



## **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.

	r, organization and numan, nonstically.			
Madula M0762, Airer	off Systems I			
Module M0763: Aircr	all Systems i			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Systems I (L0735)		Lecture	3	4
Aircraft Systems I (L0739)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in:  Mathematics Mechanics Thermodynamics Electrical Engineering Hydraulics Control Systems			
<b>Educational Objectives</b>	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge	Students are able to:  Describe essential components and design in Give an overview of the functionality of air coil Explain the need for high-lift systems such as it is Assess the challenge during the design of such	nditioning systems s ist functionality and effects	d high-lift syste	ems
Skills	Students are able to:  Design hydraulic and electric supply systems Design high-lift systems of aircrafts Analyze the thermodynamic behaviour of air			
Personal Competence				
·	Students are able to:			
Social Competence	Perform system design in groups and preser	t and discuss results		
	Students are able to:			
Autonomy	Reflect the contents of lectures autonomousl	y		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6		<u> </u>	-
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: El- Aircraft Systems Engineering: Core qualification: Co International Management and Engineering: Special Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp Product Development, Materials and Production: Sp Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Con	mpulsory lisation II. Aviation Systems: Ele ecialisation Product Developme ecialisation Production: Elective ecialisation Materials: Elective ( Aircraft Systems Engineering: E	ent: Elective Co Compulsory Compulsory Elective Comp	ompulsory



Course L0735: Aircraft Sys	tems I
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	WiSe
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>

Course L0739: Aircraft Sys	ourse L0739: Aircraft Systems I		
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	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0867: Prod	uction Planning & Control and	d Digital Enterprise		
Courses				
Title		Тур	Hrs/wk	CP
The Digital Enterprise (L0932)		Lecture	2	2
Production Planning and Contro	,	Lecture	2	2
Production Planning and Contro	, ,	Recitation Section (small)	1	1
Exercise: The Digital Enterprise	(L0933)	Recitation Section (small)	1	1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	none			
Recommended Previous Knowledge	Fundamentals of Production and Quality	Management		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.			
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.			
Personal Competence				
Social Competence	Students can develop joint solutions in mixed teams and present them to others.			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
	Compulsory Logistics, Infrastructure and Mobility: Spe Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation 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: Sp	ering: Specialisation II. Product Develop ecialisation Production and Logistics: Elective Artificial Organs and Regenerative Medicine Implants and Endoprostheses: Elective Con Medical Technology and Control Theory: Elemanagement and Business Administration: Eduction: Specialisation Product Development Eduction: Specialisation Production: Compulsion: Specialisation Materials: Elective Cecialisation Product Development and Production: Complementary Course: Elective Cecialisation Complementary Course: Elective Cecialisation Complementary Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Course: Elective Cecialisation Product Cecialisat	ve Compulsor e: Elective Con pulsory ective Compul Compulsory nt: Elective Cosory Compulsory uction: Electiv	y mpulsory ilsory ompulsory

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

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

Course L0933: Exercise: The Digital Enterprise		
Typ Recitation Section (small)		
Hrs/wk	1	
СР	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: Lase	r systems and methods of	manufacturing design and a	ınalysis	
Courses				
Title		Тур	Hrs/wk	СР
Laser Systems and Process Te Methods for Analysing Production	,	Lecture	2	3
, ,	,	Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	none			
Recommended Previous Knowledge				
<b>Educational Objectives</b>	After taking part successfully, student	s have reached the following learning	results	
<b>Professional Competence</b>				
Knowledge				
Skills	lls			
Personal Competence				
Social Competence	Social Competence			
Autonomy				
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development, Materials and Product Development, Materials and Theoretical Mechanical Engineering:	Production: Specialisation Product De Production: Specialisation Production: Production: Specialisation Materials: E Specialisation Product Development a Technical Complementary Course: El	Compulsory Elective Compulsory and Production: Electiv	, ,

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



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



Module M1174: Auto	mation Technology and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Handling and Assembly System	ns (L1591)	Lecture	2	2
Handling and Assembly System		Recitation Section (small)	1	1
Automation Technology (L1590) Automation Technology (L1739)		Lecture Recitation Section (small)	2 1	2 1
		riccitation occion (smail)	'	-
Admission Requirements	Prof. Thorsten Schüppstuhl None			
Recommended Previous Knowledge	without major course assessment			
	After taking part successfully, students have reached	the following learning results		-
Professional Competence				
, , , , , , , , , , , , , , , , , , ,	Students			
Knowledge	<ul> <li>know the characteristic components of an automation systems and have good understanding of their</li> </ul>			
Skills	<ul> <li>analyze complex Automation tasks</li> <li>develop application based concepts and solutions</li> <li>design subsystems and integrate into one system</li> <li>investigate and evaluate safety of machinery</li> <li>create simple programs for robots and programmable logic controllers</li> <li>design of circuit for pneumatic applications</li> </ul>			
Personal Competence	Students are able to			
	Students are able to			
Social Competence	- find solutions for automation and handling tasks in $\varrho$	groups		
	- develop solutions in a production environment with	qualified personnel at technica	l level and re	present 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 96, Study Time in Lecture 8-	4		
Credit points				
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe Theoretical Mechanical Engineering: Specialisation I Theoretical Mechanical Engineering: Technical Com	ecialisation Production: Compulecialisation Materials: Elective C Product Development and Prod	sory compulsory uction: Electiv	



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		
Literature		

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 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	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	SoSe	
Content		
Literature		



Module M1193: Cabi	n Systems Engineering			
Courses				
Title		Тур	Hrs/wk	СР
	echnology in cabin electronics and avionics (L1557)	Lecture	2	2
	echnology in cabin electronics and avionics (L1558)	Recitation Section (small) Project-/problem-based	1	1
Model-Based Systems Enginee	ring (MBSE) with SysML/UML (L1551)	Learning	3	3
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students are able to:     • describe the structure and operation of computer architectures     • explain the structure and operation of digital communication Networks     • explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN)     • understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems			
Skills	Students are able to:  • understand, operate and maintain a Minicomputer  • build up a network communication and communicate with other 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				
	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 84			
Credit points	6			
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			



Course L1557: Computer a	nd communication technology in cabin electronics and avionics
Тур	Lecture
Hrs/wk	2
СР	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	<ul> <li>- Skript zur Vorlesung</li> <li>- Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003</li> <li>- Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004</li> <li>- Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren. Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006</li> </ul>



Course L1558: Computer a	nd 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-Base	d 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: Electricity Generation from Wind and Hydro Power					
Courses					
Title		Тур	Hrs/wk	СР	
Renewable Energy Projects in I	Emerged Markets (L0014)	Project Seminar	1	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)	novo (L0012)	Lecture	2 1	3	
Wind Energy Use - Focus Offsl	, ,	Lecture	'	'	
Module Responsible	<u> </u>				
Admission Requirements					
	Module: Technical Thermodynamics I,				
	Module: Technical Thermodynamics II,				
Knowledge	Module: Fundamentals of Fluid Mechanics				
-	After taking part successfully, students have reached	I the following learning resu	Ilts		
Professional Competence	! !				
	By ending this module students can explain in det energy use in offshore conditions and can critical co	_	•		
	Furthermore, they are able to describe fundamenta	•		· ·	
	reproduce and explain the basic procedure in the im	-	-	-	
Knowledge	Europe.				
	Through active discussions of various topics within t	he seminar of the module, s	tudents improve th	eir understanding	
	and the application of the theoretical background an	d are thus able to transfer w	hat they have lear	ned in practice.	
	Ctudents are able to apply the applying the avetice	l faundations on average		over eveteme and	
	Students are able to apply the acquired theoretical evaluate and assess technically the resulting relations.				
Skills	energy systems. They can in compare critically the special procedure for the implementation of renewable energy				
Onno	projects in countries outside Europe with the in prin-	ciple applied approach in E	urope and can ap	ply this procedure	
	on exemplary theoretical projects.				
Personal Competence					
Social Compotones	Students can discuss scientific tasks subjet-specific	ly and multidisciplinary with	in a seminar.	j	
Social Competence				ļ	
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the				
Autonomy	contents of the lecture and to acquire the particular knowledge about the subject area.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Examination	Written exam				
Examination duration and scale	3 hours written exam				
	Civil Engineering: Specialisation Structural Enginee				
Assignment for the Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	•	ry		
	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. Energy and Environmental Engineering: Elective				
	· · ·				
	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				
	Renewable Energies: Core qualification: Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory				
	Water and Environmental Engineering: Specialisation	•	•		



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



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

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



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



Module M0630: Robo	otics and Navigation in Medicine			
Courses				
Title Robotics and Navigation in Med Robotics and Navigation in Med	dicine (L0338)	<b>Typ</b> Lecture Project Seminar	Hrs/wk 2 2	<b>CP</b> 3 2
Robotics and Navigation in Med	dicine (L0336)	Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>principles of programming e.g. in Java or C+</li> </ul>	•		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in details. Systems can be evaluated with respect to collision detection and safety and regulations. Students can assess typical systems regarding design and limitations.			
Skills	The students are able to design and evaluate naviga	tion systems and robotic systen	ns for medical	applications.
Personal Competence  Social Competence	The students discuss the results of other groups, pro work.  The students can reflect their knowledge and docum		·	
Autonomy	appropriate manner.			
	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 minutes			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engin Electrical Engineering: Specialisation Medical Techn Computational Science and Engineering: Specialisation International Management and Engineering: Specialisation Mechatronics: Specialisation Intelligent Systems and Biomedical Engineering: Specialisation Artificial Orga Biomedical Engineering: Specialisation Implants and Biomedical Engineering: Specialisation Medical Tech Biomedical Engineering: Specialisation Managemen Product Development, Materials and Production: Specialisation Development, Materials and Production: Specialisation Medical Engineering: Specialisation Froduct Development, Materials and Production: Specialisation Medical Engineering: Technical Com Theoretical Mechanical Engineering: Specialisation Mechanical Engineerin	tiology: Elective Compulsory tion Systems Engineering and I isation II. Electrical Engineering and I Robotics: Elective Compulsory ans and Regenerative Medicine Endoprostheses: Elective Conthology and Control Theory: Elet and Business Administration: ecialisation Product Developme ecialisation Production: Elective Control Elective Elective Control Elective Elective Control Elective Elec	g: Elective Con re: Elective Con npulsory ective Compu Elective Compu ent: Elective Co e Compulsory Compulsory	npulsory npulsory sory pulsory ompulsory



Course L0335: Robotics and Navigation in Medicine		
Тур	Lecture	
Hrs/wk	2	
СР	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	urse L0338: Robotics and Navigation in Medicine	
Тур	Project Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	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
СР	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



	ly Chain Management			
Courses				
Title		Тур	Hrs/wk	СР
Supply Chain Management (L12	18)	Project-/problem-bas		4
Value-Adding Networks (L1190)	,	Learning Lecture	2	2
<u> </u>	Dorf Theories Division	Lecture	2	2
Module Responsible	no			
Admission Requirements	110			
Recommended Previous Knowledge	no			
<b>Educational Objectives</b>	After taking part successfully, studen	ts have reached the following learning i	esults	
Knowledge	globalization and emerging markets  Theoretical Approaches and metho  to identify fields of decision in SCM  reasons for the formation of network theory, principal-agent theory, prope  Selected approaches to explain the  to illustrate phases of network forma  to understand the functional mecha  to explain and categorize relationsh  to categorize sourcing concepts and advantages and disadvantages of terms  to state criteria/ factors/ parameters costs).  to explain methods for location find  to interpret phenotypes of production recognize relationships between R  to solve sub-problems with the coruse of appropriate approaches.  to categorise special waste logis	orks based on various theories from in try-right theory) and the resource-based development of networks. ation. Inisms of inter-organizational and internings within networks. It is a captain motives/barriers or advantage of offshoring and outsourcing and to ill state influence production location decing/evaluation.	ement and use in pra- nstitutional economic l view.  ational network relati es and disadvantage ustrate the distinction cisions at the global and to describe cohe ution and spare part	ctice. cs (transaction conships. s. n between the two level (total netwo
Skills	• to asses trends and challenges in national and international supply chains and logistics networks and the 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 advantage 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 and evaluate the product development processes. • 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. • to adopt methods of complexity management and risk management in logistics.			
Personal Competence				
Social Competence	• to evaluate intercultural and international relationships based on discussed case studies. • advance planning and design of network formation and their objectives based on content discussed in the lectur • definition of procurement strategies for individual parts using the gained knowledge of procurement networks. • design of the procurement network (external/internal/modules etc.) based on the sourcing concepts and co competencies, as well as on the findings of the case studies. • to make decision of location for production taking into account global contexts, evaluation methods as buying/selling markets, which were also discussed in the case studies and their dependence on R & D. • Decision on R & D locations based on the insights gained from case studies / practical examples and the selection of an appropriate model.			
	After completing the module stude Management and transfer the acquir	ents are capable to work independe ed knowledge to new problems.	ently on the subject	t of Supply Cha
Workload in Hours	Independent Study Time 110, Study	Time in Lecture 70		
	· · · · · · · · · · · · · · · · · · ·			
Credit points	~			
Credit points  Examination				



## Assignment for the Following Curricula

International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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 L1218: Supply Chai	in 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	<ul> <li>Transmission of a profound understanding in logistics and supply chain management</li> <li>Transmission of theoretical approaches and methods in the field of logistics and supply chain management; transfer from theoretical concepts to business cases</li> <li>Identification of trends and challenges in national and international supply chains</li> <li>Elaboration and critical discussions concerning different supply chain configurations, as well as strategic supply chain approaches (e.g. push or pull-based strategies, efficiency vs. responsiveness)</li> <li>Elaboration of approaches and goals in the field of resource planning and supplier management</li> <li>Identification and analyzes of concepts in logistics management</li> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul> Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.],
Literature	McGraw-Hill/Irwin.  Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 <sup>rd</sup> edition, Upper Saddle River, NJ, Pearson/Prentice Hall.  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.



Course L1190: Value-Addin	ng 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	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmenstzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>



Module M0764: Aircr	aft Systems II			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Systems II (L0736)		Lecture	3 2	4 2
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
	Prof. Frank Thielecke			
Admission Requirements	basic knowledge of:			
Recommended Previous Knowledge	mathematics     mechanics     thermo dynamics     electronics     fluid technology     control technology			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence		-		
	Students are able to			
Knowledge	<ul> <li>describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gea systems in general along with corresponding properties and applications.</li> <li>explain different configurations and designs and their origins</li> <li>explain atmospheric conditions for icing such as the functionality of anti-ice systems</li> </ul>			
Skills	Students are able to  size primary flight control actuation system perform a controller design process for the design high-lift kinematics design and analyse landing gear systems design anti-ice systems			
Personal Competence				
Social Competence	Students are able to:			
	Develop joint solutions in mixed teams			
	Students are able to:			
Autonomy	derive requirements and perform appropriate complex issues and circumstances in a set.		cesses for airc	raft systems fron
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
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: Specialisation Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: 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	<ul> <li>Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems)</li> <li>Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems)</li> <li>Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems)</li> <li>Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank)</li> </ul>	
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>Curry: Aircraft Landing Gear Design: Principles and Practices</li> </ul>	

Course L0740: Aircraft Sys	ourse 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: Medi	cal Imaging Systems			
Courses				
Title		Тур	Hrs/wk	СР
Medical Imaging Systems (L081	9)	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 re	sults	
Professional Competence				
Knowledge	<ul> <li>Name and describe the physical effe</li> <li>Explain how spatial and temporal generated;</li> <li>Explain which image reconstruction in the properties of the physical effects.</li> </ul>	and the overall system of the ima occesses that make imaging pos cts required to generate image co resolution can be influenced a methods are used to generate image.	iging systems functionsible and use with ontrasts; and how to charact	the fundamental
Skills	<ul> <li>Determine the influence of dimaging systems;</li> </ul>	maging systems using the mather lifferent system components on terent imaging systems for a numb	natical or physical ed the spatial and temp	quations; poral resolution of
Personal Competence				
Social Competence	none			
Autonomy	Understand which physical effects ar     Decide independently for which clinic	5 5.	n be used.	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medic Biomedical Engineering: Core qualification: Product Development, Materials and Produc Product Development, Materials and Produc Product Development, Materials and Produc Theoretical Mechanical Engineering: Specia Theoretical Mechanical Engineering: Techni	Compulsory  ction: Specialisation Product Deve  ction: Specialisation Production: E  ction: Specialisation Materials: Ele  alisation Bio- and Medical Techno	elopment: Elective Co elective Compulsory ective Compulsory elogy: Elective Comp	



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		
	Primary book:  1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press  Secondary books:  - A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003.  - W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002.  - H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995.  - O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.	



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

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Project-/problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Poly	rmers (L0389)	Lecture	2	3
Structure and Properties of Con		Lecture	2	3
Elements of Integrated Producti	on Systems (L0927)	Project-/problem-based	2	3
_		Learning		
•	ed Product Development (L1703)	Seminar	2	2 3
Development Management for Management for Management and Probability	pilistic Approaches in Structural Analysis (L1814)	Lecture Seminar	3	3
Fatigue & Damage Tolerance (L		Lecture	2	3
Joining of Polymer-Metal Lightw		Lecture	2	2
Joining of Polymer-Metal Lightw	eight Structures (L0501)	Practical Course	1	1
Design with Polymers and Com	posites (L0057)	Lecture	2	3
	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Co	urse (L1258)	Project-/problem-based Learning	3	3
Mechanisms Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap		Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	(24)	Lecture	2	4
Productivity Management (L092	(8)	Project-/problem-based	2	2
, ,	,	Learning		
Productivity Management (L093		Recitation Section (small)	1 2	1 3
Feedback Control in Medical Te Renewable Energy (L0313)	erinology (£0004)	Lecture Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpo	rtation (L0855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam		Lecture	2	2
Reliability in Engineering Dynam Reliability of Aircraft Systems (L		Recitation Section (small) Lecture	1 2	2 3
	,	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	Only one of the modules "Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)" or "Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)" can be selected.			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence		<del></del>		
Knowledge	Students are able to express their extended knowledge and discuss the connection of different special fields			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence Social Competence				
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	12			
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				



Course L1592: Applied Auto	omation
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of	Integrated Production Systems
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
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 Iernen: 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.



Typ Seminar  Hrs/wk 2  CP 2  Workload in Hours Independent Study Time 32, Study Time in Lecture 28  Examination Form Referat  Examination duration and scale  Lecturer Jörg Heuser  Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	Course L1703: Emotional Design / User Centered Product Development	
CP 2  Workload in Hours Independent Study Time 32, Study Time in Lecture 28  Examination Form Referat  Examination duration and scale Teamarbeit und abschließender Vortrag  Lecturer Jörg Heuser  Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	Тур	Typ Seminar
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  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	Hrs/wk 2	s/ <b>wk</b> 2
Examination Form Referat  Examination duration and scale Teamarbeit und abschließender Vortrag  Lecturer Jörg Heuser  Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	CP 2	<b>CP</b> 2
Examination duration and scale  Lecturer Jörg Heuser  Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	Workload in Hours	burs Independent Study Time 32, Study Time in Lecture 28
Lecturer Jörg Heuser  Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product		
Language DE  Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	nination duration and scale	and Teamarbeit und abschließender Vortrag
Cycle SoSe  Lecture  Objective and subjective perception for the evaluation of product characteristics  Effects of material, color, shape and structure to the acceptance of a product	Lecturer	urer Jörg Heuser
Lecture  Objective and subjective perception for the evaluation of product characteristics Effects of material, color, shape and structure to the acceptance of a product	Language [	age DE
<ul> <li>Objective and subjective perception for the evaluation of product characteristics</li> <li>Effects of material, color, shape and structure to the acceptance of a product</li> </ul>	Cycle	ycle SoSe
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	<b>Content</b>	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
Literature Wird in der Veranstaltung angegeben	Literature \	ture Wird in der Veranstaltung angegeben

Course L1512: Developmen	nt 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	L3O 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	Ica 10 Selten ling Disklission
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
	<ul> <li>[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011.</li> <li>[2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley</li> <li>Sons New York/Chichester, UK, 2000.</li> </ul>

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



Course L0500: Joining of Polymer-Metal Lightweight Structures	
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	
Cycle	
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Content	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



avT	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
	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; Engineeri 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultar 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-V 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; Ex transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffned requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into accoun
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	current edition.  • Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition



Hrs/wk 1  CP 1  Workload in Hours Independent Study Time 16, Study Time in Lecture 14  Examination Form Mündliche Prüfung  Examination duration and scale DE  Cycle WiSe  Fundamentals of Anisotropic Elasticity  Displacements, strains and stresses; Equilibrium equations; Kinematics; Hours Behaviour of a single laminate layer  Material law of a single laminate layer; Full anisotropy and coupling et constants; Plane state of stress; Transformation rules  Fundamentals of Micromechanics of a laminate layer  Representative unit cell; Determination of effective material constants; Effect Classical Laminate Plate Theory  Notations and laminate code; Kinematics and displacement field; Sinconstitutive equations and coupling effects; Special laminates and their be Strength of Laminated Plates  Content  Fundamental concept; Phenomenological failure criteria: maximum stress Puck, Hashin  Bending of Composite Laminated Plates	
Workload in Hours   Independent Study Time 16, Study Time in Lecture 14	
Workload in Hours Independent Study Time 16, Study Time in Lecture 14  Examination Form Mündliche Prüfung  Examination duration and scale  Lecturer Dr. Marco Schürg  Language DE  Cycle WiSe  Fundamentals of Anisotropic Elasticity  Displacements, strains and stresses; Equilibrium equations; Kinematics; Hours Behaviour of a single laminate layer  Material law of a single laminate layer; Full anisotropy and coupling electoristants; Plane state of stress; Transformation rules  Fundamentals of Micromechanics of a laminate layer  Representative unit cell; Determination of effective material constants; Effect Classical Laminate Plate Theory  Notations and laminate code; Kinematics and displacement field; Seconstitutive equations and coupling effects; Special laminates and their be Strength of Laminated Plates  Content  Fundamental concept; Phenomenological failure criteria: maximum stress Puck, Hashin  Bending of Composite Laminated Plates	
Examination Form Mündliche Prüfung  Examination duration and scale  Lecturer Dr. Marco Schürg  Language DE  Cycle WiSe  Fundamentals of Anisotropic Elasticity  Displacements, strains and stresses; Equilibrium equations; Kinematics; Howard Behaviour of a single laminate layer  Material law of a single laminate layer; Full anisotropy and coupling etconstants; Plane state of stress; Transformation rules  Fundamentals of Micromechanics of a laminate layer  Representative unit cell; Determination of effective material constants; Effect Classical Laminate Plate Theory  Notations and laminate code; Kinematics and displacement field; Strength of Laminated Plates  Content  Fundamental concept; Phenomenological failure criteria: maximum stress Puck, Hashin  Bending of Composite Laminated Plates	
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Content Fundamental concept; Phenomenological failure criteria: maximum stress Puck, Hashin  Bending of Composite Laminated Plates	
Puck, Hashin  Bending of Composite Laminated Plates	
	es, maximum strains, Tsai-Hill, Tsai-W
Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-ty	pe solutions
Stress Concentration Problems	
Free-edge effects; Stress concentrations at holes, cracks, delaminations; As	spects of failure analysis
Stability of Thin-Walled Composite Structures	
Buckling of anisotropic plates and shells; Influence of loading conditions; transcendental solutions and their evaluation; Buckling of stiffened requirements; Local buckling of stiffener profiles	
Written exercise (report required)	
Assessment of a thin-walled composite laminated beam taking several diffe	erent dimensioning criteria into account
Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Spr	
<ul> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Hei</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and She current edition.</li> </ul>	Ils", CRC Publishing, Boca Raton et
<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co.,</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGracurrent edition.</li> </ul>	aw-Hill Book Company, Inc., New Yo
<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of compos current edition.</li> </ul>	ite plates", Chapman and Hall, Londo
<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley an</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", akt</li> </ul>	done to Mr. W. L



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

Course L0950: Mechanisms	s, 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sicher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Design I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and scale	L12() Minuten	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	WiSe	
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation	
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"	



Course L0834: Aircraft Design I		
Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor; pi junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, picersistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas sensor, paraba probe, MOSFET gas se</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
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 C	ontrol in Medical Technology			
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Mündliche Prüfung			
Examination duration and scale				
Lecturer	Ulf Pilz, Prof. Olaf Simanski			
Language	DE			
Cycle	SoSe			
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.			
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart  Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag  M.C.K.Khoo: "Physiological Control System", IEEE Press, 2000			

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



Course L1434: Renewable Energy			
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	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 exercises esson and discuss it with other students and the lecturer.  Possible tasks in the field of renewable energies are:  Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		

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



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

Course L1513: Technical Design				
Typ Lecture				
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Schriftliche Ausarbeitung			
Examination duration and scale	I (Hausarbeit)			
Lecturer	Prof. Werner Granzeier			
Language				
Cycle	SoSe			
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>			
	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			
	[227]			



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH

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

Course L0949: Materials Te	esting			
Тур	Lecture			
Hrs/wk				
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	<ul> <li>Application and analysis of basic mechanical as well as non-destructive testing of materials</li> <li>Determination elastic constants</li> <li>Tensile test</li> <li>Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect)</li> <li>Crack growth upon static loading (stress intensity factor, fracture toughness)</li> <li>Creep test</li> <li>Hardness test</li> <li>Charpy impact test</li> <li>Non destructive testing</li> </ul>			
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill			



Course L0176: Reliability in Engineering Dynamics				
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form				
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			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Examination Form				
Examination duration and scale	90 min			
-	Prof. Uwe Weltin			
Language	EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			

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



Madula M11/2: Maak	agnical Design Mathedalogy			
Module WT 143: Mecr	nanical Design Methodology			
Courses				
Title		Тур	Hrs/wk	СР
Mechanical Design Methodology	• •	Lecture	3	4
Mechanical Design Methodology	y (L1524)	Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	none			
Recommended Previous				
Knowledge	Afficial in a second Heat dealers	and the fellowing to the section of the		
	After taking part successfully, students hav	e reached the following learning results		
Professional Competence	Science-based working on product design	associated application of associ	fic are duet do	aian taabniawaa
Knowledge	Science-based working on product design	considering largeted application of speci	ilic product de	sign 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				İ
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation 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 Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

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



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



Module M1144: Manu	ufacturing with Polymers and Com	posites - From Molecule t	to Part	
Courses				
Title		Тур	Hrs/wk	СР
Manufacturing with Polymers ar	nd Composites (L0511)	Lecture	2	3
From Molecule to Composites F	Part (L1516)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	Non			
Recommended Previous	Structure and Properties of Polymers			
	Structure and Properties of Composites			
Educational Objectives	I. After taking part successfully, students have re	ached the following learning results	;	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes polymers and composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practical problems. They identify and overcome typical problems during the realization of projects in the context of civil engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.			
Personal Competence				
Social Competence	Students are able to cooperate in small, mixe problems in the context of civil engineering. The groups in front of a qualified audience. Stems engineering problem independently or in groups.	ney are able to effectively present a udents have the ability to develo	nd explain their op alternative a	results alone or in
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 Time in Le	ecture 56		
Credit points	6			
	Written elaboration			
Examination duration and scale	1,5 h			
Assignment for the Following Curricula	Teroduci Development, Majeriais and Production, Specialisation Product Development, Elective Compulsory			

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



Course L1516: From Molecule to Composites Part			
Тур	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 M1145: Auto	mation and Simulation				
Courses					
Title		Тур	Hrs/wk	СР	
Automation and Simulation (L15 Automation and Simulation (L15	•	Lecture Recitation Section (large)	3	3	
Module Responsible	Prof. Günter Ackermann				
Admission Requirements	none				
Recommended Previous Knowledge	BSc Mechanical Engineering or similar				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results			
Professional Competence					
	Students can describe the structure an the function transfer via bus systems an programmable logic of	•	esponding cor	nponents, the data	
Knowledge	They can describe the basich principle of a nume	ric simulation and the correspondi	ng parameters	S.	
Mowieage	Thy can explain the usual method to simulate the	dynamic behaviour of three-phase	e machines.		
	Students can describe and design simple controll	ers using established methodes.			
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.				
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					
•	Teamwork in small teams.				
Coolai Competence		ocic analysises in the field of a	utomation svs	tems, to do these	
Autonomy	Students are able to identify the need of methocic analysises in the field of automation systems, to do the analysisis in an adequate manner und to evaluate the results critically.				
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70			
Credit points	6				
Examination	Oral exam				
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde				
Assignment for the Following Curricula	Tinternational Management and Engineering Specialisation it Product Development and Production Electiv				



Course L1525: Automation	and Simulation		
Тур	Lecture		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Günter Ackermann		
Language	DE		
Cycle	SoSe		
	Structure of automation systsems		
	Aufbau von Automationseinrichtungen		
	Structure and function of process computers and corresponding componentes		
	Data transfer via bus systems		
Content	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	urse L1527: Automation and Simulation		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Günter Ackermann		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M1156: Syste	ems Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Systems Engineering (L1547)		Lecture	3	4
Systems Engineering (L1548)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Licetical Engineering			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence	<u> </u>	le lollowing learning results		
·	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 Syst • organize the development phases and development • assign required business activities and technical Tasl • apply systems engineering methods and tools	Tasks		
Personal Competence				
Social Competence	Students are able to:	nt team and integrate themse	lves with their	role in the overal
Autonomy	Students are able to: interact and communicate in a development team whi	ich has distributed tasks		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	3		
Credit points	6			
	Written exam			
Examination duration and scale	I 120 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: Comp International Management and Engineering: Specialisa International Management and Engineering: Special Compulsory	ation II. Aviation Systems: Ele disation II. Product Develop Compulsory Robotics: Elective Compulsory dialisation Product Developme dialisation Production: Elective	ment and Pr , ent: Compulso e Compulsory	oduction: Elective



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

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



Module M1161: Turb	omachinery			
Courses				
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Franz Joos			
Admission Requirements	none			
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamic	s, Heat Transfer		
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	The students can  distinguish the physical phenomena of understand the different mathematic mo calculate and evaluate turbomachinery	odelling of turbomachinery,		
Skills	The students are able to - understand the physics of Turbomachinery, - solve excersises self-consistent.			
Personal Competence				
Social Competence	The students are able to  • discuss in small groups and develop ar	n approach.		
Autonomy	The students are able to  develop a complex problem self-consis  analyse the results in a critical way,  have an qualified exchange with others			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy System Energy Systems: Specialisation Marine Engine Product Development, Materials and Productio Product Development, Materials and Productio Product Development, Materials and Productio	ering: Elective Compulsory n: Specialisation Product Developmon: n: Specialisation Production: Electivo	e Compulsory	ompulsory



Course L1562: Turbomachines		
Тур	Lecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	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	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>	

Course L1563: Turbomachines	
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: Phen	nomena and Methods in Materia	Is Science		
Courses				
TitleTypHrs/wkCPExperimental Methods for the Characterization of Materials (L1580)Lecture23Phase equilibria and transformations (L1579)Lecture23		3		
Module Responsible	Prof. Patrick Huber			
Admission Requirements	none.			
Recommended Previous Knowledge	Fundamentals of Materials Science (I and I	II)		
Educational Objectives	After taking part successfully, students have	e reached the following learning res	sults	
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 enocialists and to develop ideas	further	
Social Competence	The students are able to present solutions	to specialists and to develop ideas	iururer.	
Autonomy	The students are able to  assess their own strengths and wea define tasks independently.	aknesses.		
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
	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 Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course I 1580: Experimenta	al Methods for the Characterization of Materials
•	Lecture Lecture
Hrs/wk	
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).  William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).



Course L1579: Phase equilibria and transformations	
Тур	Lecture
Hrs/wk	2
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.

Courses



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

Title		Тур	Hrs/wk	СР
Applied Automation (L1592)		Project-/problem-based Learning	3	3
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Composites (L0513)		Lecture	2	3
Structure and Properties of Cor	riposites (Loo 10)		۷	3
Elements of Integrated Producti	ion Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Center	red Product Development (L1703)	Seminar	2	2
Development Management for I	Mechatronics (L1512)	Lecture	2	3
Design Optimization and Probal	bilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (I		Lecture	2	3
Joining of Polymer-Metal Lightw	•	Lecture	2	2
, ,	, ,	Practical Course	1	1
Joining of Polymer-Metal Lightw				•
Design with Polymers and Com		Lecture	2	3
Lightweight Construction with F	ibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with F	ibre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Limbturainht Danima Brantinal Ca		Project-/problem-based	0	0
Lightweight Design Practical Co	uise (L1238)	Learning	3	3
Mechanisms. Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	- · · · · · · · · · · · · · · · · · · ·	Lecture	2	3
·	P. 10011)		2	
Aircraft Design I (L0820)		Lecture		2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	724)	Lecture	2	4
Productivity Management (L092	28)	Project-/problem-based	2	2
1. Toddottvity ivianagement (£092		Learning	_	_
Productivity Management (L093	31)	Recitation Section (small)	1	1
Feedback Control in Medical Te		Lecture	2	3
Renewable Energy (L0313)	3, ( 111 )	Lecture	2	2
9, 1			1	1
Renewable Energy (L1434)		Recitation Section (small)		
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpo	rtation (L0855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	nice (L0176)	Lecture	2	2
Reliability in Engineering Dynam		Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)  Lecture 2 3		3		
Module Responsible	Prof. Dieter Krause			
Admission Requirements	Only one of the modules "Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 CP)" or "Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 CP)" can be selected.			
Recommended Previous	None			
Knowledge	1			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	<ul> <li>Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production</li> <li>Students are qualified to connect different special fields with each other</li> </ul>			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence				
Social Competence	-			j
Sour Somptione				ļ
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the Following 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			ompulsory	
			. ,	



Course L1592: Applied Automation		
	Project-/problem-based Learning	
Hrs/wk		
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Dr. Hans Wittich	
Language	DE	
Cycle	WiSe	
Content		
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	



Course L0513: Structure and Properties of Composites		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of	Integrated Production Systems
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
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	Objective and subjective perception for the evaluation of product characteristics     Effects of material, color, shape and structure to the acceptance of a product     Aesthetic function of a product     Case studies, lack of acceptance of a product and possible reason  Seminar     Identification of non-technical product functions     Identification of subjective influences for the product development  Project Work     Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated  Exemplary Project: Holistic product evaluation, product optimization	
Literature	Wird in der Veranstaltung angegeben	

Тур	Lecture
Hrs/wk	
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
<b>Examination Form</b>	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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung de Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerect anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ICA 10 Selten lind Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	EN
Cycle	
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Contone	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



Course L1514: Lightweight	Construction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
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; Exactranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York</li> </ul>
	<ul> <li>current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London current edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> </ul>
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.



Course L1515: Lightweight	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
	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
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al. current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New York</li> </ul>
Literature	current edition.  • Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London current edition.
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



Course L1258: Lightweight Design Practical Course	
Typ Project-/problem-based Learning	
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0950: Mechanisms	s, 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	190 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Des	sign 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  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I		
Тур	Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching; back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistive, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomapnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
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 C	Course L0664: Feedback Control in Medical Technology	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Ulf Pilz, Prof. Olaf Simanski	
Language	DE	
Cycle	SoSe	
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.	
Literature	Silbernagel/Depopoulos: Taschenatlas der Physiologie, Thieme Verlag Stuttgart  Werner: Kooperative und autonome Systeme der Medizintechnik, Oldenburg Verlag  M.C.K.Khoo: "Physiological Control System", IEEE Press, 2000	

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



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

Oniman I 1100, Cir. Cimma	
Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



Course L0855: System Analysis in Air Transportation	
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	
Examination duration and scale	60 Minuten
Lecturer	Dr. Marco Weiss
Language	DE
Cycle	WiSe
Content	1. Introduction to the Air Transport System 2. System analysis methodologies 3. Technology management 4. Technical analysis methods 5. Economical analysis methods 6. Ecological analysis methods 7. Societal analysis methods 8. Research on the future 9. Synthesis, overall assessment, decision making 10. Case studies - Technology Push 11. Case studies - Scenario Pull
Literature	Hand out

,	
Course L1513: Technical De	esign
	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen
	Literaturhinweise
	What is Product Design ?
	Laura Slack
	Roto Vision Schweiz 2006
	Product Design Now
	Design and Scetches
	CollinsDesign and maomao publications Spanien 2006
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques
	for Designers, Illustrators and Architects,
	Watson, Guptil Puplications,a division of Billboard Publications Inc.,
	New York 1983
	Creative Techniques



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH Hambure University of Technolog

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

Course L0949: Materials Te	esting
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
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	
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	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	f Aircraft Systems
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>



Module M1226: Mech	nanical Properties			
Courses				
Title		Tun	Hrs/wk	СР
Mechanical Behaviour of Brittle	Materials (L1661)	<b>Typ</b> Lecture	nrs/wk 2	3
Dislocation Theory of Plasticity		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 have	ve reached the following learning re	sults	
Professional Competence				
Knowledge	Students can explain basic principles of c (energy minimization, energy barriers, en		grams, tractions) and	d thermodynamics
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 - assess their own state of learning in specific terms and to define further work steps on this basis guided teachers.			
Autonomy				
	- work independently based on lectures and notes to solve problems, and to ask for help or clarifications when needed			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula	Materials Science: Core qualification: Cor Mechanical Engineering and Managemer Product Development, Materials and Prod Product Development, Materials and Prod Product Development, Materials and Product Development De	nt: Specialisation Materials: Elective luction: Specialisation Product Develuction: Specialisation Production: E	lopment: Elective Co lective Compulsory	ompulsory



Course L1661: Mechanical	Behaviour of Brittle Materials	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Gerold Schneider	
Language	DE/EN	
Cycle	SoSe	
	Theoretical Strength Of a perfect crystalline material, theoretical critical shear stress	
	Real strength of brittle materials  Energy release reate, stress intensity factor, fracture criterion	
	Scattering of strength of brittle materials Defect distribution, strength distribution, Weibull distribution	
	Heterogeneous materials I Internal stresses, micro cracks, weight function,	
	Heterogeneous materials II Toughening mechanisms: crack bridging, fibres	
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: Optin	nal and Robust Control			
Courses				
Title Optimal and Robust Control (L0 Optimal and Robust Control (L0		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible Prof. Herbert Werner				
	Control Systems Theory and Design			
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Classical control (frequency response</li> <li>State space methods</li> <li>Linear algebra, singular value decomption</li> </ul>	,		
Educational Objectives	After taking part successfully, students have re	eached the following learning results	3	
<b>Professional Competence</b>				
Knowledge	<ul> <li>Students can explain the significance</li> <li>They can explain the duality between</li> <li>They can explain how the H2 and constraints.</li> <li>They can explain how an LQG design</li> <li>They can explain how model uncertadesign</li> <li>They can explain how - based on the performance for an uncertain plant.</li> <li>They understand how analysis and smatrix inequalities.</li> </ul>	optimal state feedback and optimal s H-infinity norms are used to rep problem can be formulated as speci ainty can be represented in a way t e small gain theorem - a robust con	state estimation. resent stability al case of an H2 hat lends itself t	and performand design problem o robust controll antee stability an
Skills	<ul> <li>Students are capable of designing and tuning LQG controllers for multivariable plant models.</li> <li>They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it.</li> <li>They are capable of translating time and frequency domain specifications for control loops into constraints on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design.</li> <li>They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller.</li> <li>They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them.</li> <li>They can carry out all of the above using standard software tools (Matlab robust control toolbox).</li> </ul>			
Personal Competence				
•	Students can work in small groups on specific	problems to arrive at joint solutions	-	
, , , , , , , , , , , , , , , , , , , ,	Students are able to find required information			re documentatio
Autonomy	and use it to solve given problems.	. ,		
Autonomy				
	Independent Study Time 124, Study Time in L	Lecture 56		
Credit points  Examination				
Examination duration and	Oral exam			
scale	30 min			
Assignment for the Following Curricula	I Diamandian I Francisco de calcidantina Inschanta and Francisco de Cartera Canada de Cartera Canada de Cartera			



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

Course L0659: Optimal and	urse L0659: Optimal and Robust Control		
Тур	Typ Recitation Section (small)		
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	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
		Learning		
Ergonomics (L0653)	(1.0000)	Lecture	2	3
Structure and Properties of Con		Lecture Lecture	2	3 3
Structure and Properties of Composites (L0513)		Project-/problem-based		-
Elements of Integrated Production Systems (L0927)		Learning	2	3
Emotional Design / User Center	ed Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)		Lecture	2	3
= :	pilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (L		Lecture	2	3
Joining of Polymer-Metal Lightw		Lecture	2	2
Joining of Polymer-Metal Lightw		Practical Course	1 2	1 3
Design with Polymers and Com	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture Lecture	2	2
	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
		Project-/problem-based		
Lightweight Design Practical Co	urse (L1258)	Learning	3	3
Mechanisms, Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	plications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	(24)	Lecture	2	4
Productivity Management (L092	(8)	Project-/problem-based	2	2
		Learning	_	_
Productivity Management (L093	•	Recitation Section (small)	1 2	1 3
Feedback Control in Medical Te Renewable Energy (L0313)	erificition (L0664)	Lecture Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpor	rtation (L0855)	Lecture	3	3
Technical Design (L1513)	(	Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	ics (L0176)	Lecture	2	2
Reliability in Engineering Dynam	ics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L	0749)	Lecture	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements				
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
<b>Professional Competence</b>				
Knowledge	<ul> <li>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</li> <li>Students are qualified to connect different special fields with each other</li> </ul>			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence				
Social Competence	-			
Autonomy				
Workload in Hours	Depends on choice of courses			
	redit points 12			
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				



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		
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Typ Lecture	
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of	Integrated Production Systems
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
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 Iernen: 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.



Typ S Hrs/wk 2	Seminar
Hrs/wk 2	
1113/WK Z	
CP 2	
Workload in Hours In	ndependent Study Time 32, Study Time in Lecture 28
Examination Form R	
Examination duration and scale $T^{G}$	eamarbeit und abschließender Vortrag
<b>Lecturer</b> Jo	örg Heuser
<b>Language</b> D	DE CONTRACTOR OF THE CONTRACTO
Cycle S	SoSe
S Content P	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  deminar  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 W	Vird in der Veranstaltung angegeben

Тур	Lecture
Hrs/wk	
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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung de Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerech anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	Ica 10 Selten ling Disklission
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
	<ul> <li>[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011.</li> <li>[2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley</li> <li>Sons New York/Chichester, UK, 2000.</li> </ul>

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	EN
Cycle	WiSe
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



₹	Lecture
	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineeric 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 resultan 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-W 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; Exatranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffne requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et a current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Yo</li> </ul>
	<ul> <li>current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Londocurrent edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> </ul>



	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Recitation Section (large)
Hrs/wk	
	Independent Study Time 16, Study Time in Lecture 14  Mündliche Prüfung
Examination duration and	<u> </u>
scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineeri 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultar 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-V 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; Ex transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffned requirements; Local buckling of stiffener profiles
	Written exercise (report required)
	Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into accoun
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> </ul>
Literature	<ul> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Yocurrent edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current editior</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



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

O 1.0050 M1	Outline and Decree of Materials Testion
	s, 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	190 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Des	sign 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	L120 Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I		
Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process;</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxid semiconductor gas sensor, organic semiconductor gas sensor, capacitive; passive and active, micropumps valveless micropump, electrokinetic micropumps,</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

Course L0313: Renewable	Energy
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



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

Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical De	esign
	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	(Hausarbeit)
Lecturer	Prof. Werner Granzeier
Language	
Cycle	SoSe
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen
	Literaturhinweise
	What is Product Design ?
	Laura Slack
	RotoVision Schweiz 2006
	Product Design Now
	Design and Scetches
	CollinsDesign and maomao publications Spanien 2006
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques
	for Designers, Illustrators and Architects,
	Watson, Guptil Puplications,a division of Billboard Publications Inc.,
	New York 1983
	Creative Techniques



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

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

TUHH Hambure University of Technolog

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

Course L0949: Materials Tes	sting		
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	I 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		
	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			
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			
Typ Recitation Section (small)			
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Examination Form			
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	f Aircraft Systems		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form			
Examination duration and scale	90 Minuten		
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>		
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>		



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

Courses				
Title		Тур	Hrs/wk	СР
		Project-/problem-based		
Applied Automation (L1592)	Learning	3	3	
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Com	nposites (L0513)	Lecture	2	3
Elements of Integrated Production	on Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Center	ed Product Development (L1703)	Seminar	2	2
Development Management for M	•	Lecture	2	3
• ,	oilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (L		Lecture	2	3
Joining of Polymer-Metal Lightwo		Lecture	2	2
Joining of Polymer-Metal Lightwe		Practical Course	1	1
Design with Polymers and Comp		Lecture	2	3
= =	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
Lightweight Construction with Fil	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
Lightweight Design Practical Con	urse (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Prod	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft App	plications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L07	24)	Lecture	2	4
Productivity Management (L092	8)	Project-/problem-based Learning	2	2
Productivity Management (L093	Productivity Management (L0931)		1	1
Feedback Control in Medical Te	chnology (L0664)	Lecture	2	3
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpor	rtation (L0855)	Lecture	3	3
Technical Design (L1513)		Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynamics (L0176)		Lecture	2	2
Reliability in Engineering Dynamics (L1303)		Recitation Section (small)	1	2
Reliability of Aircraft Systems (L	0749)	Lecture	2	3
Module Responsible				
Admission Requirements	none			
Recommended Previous Knowledge	None			
-	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	<ul> <li>Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production</li> <li>Students are qualified to connect different special fields with each other</li> </ul>			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence				
Social Competence				
Autonomy	Students are able to develop their knowledge and skills by autonomous election of courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the Following Curricula	Product Development Materials and Production, Specialisation Production, Flective Compilisory			



Course L1592: Applied Auto	
	Project-/problem-based Learning
Hrs/wk	
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Typ Lecture	
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	<ul> <li>- Microstructure and properties of the matrix and reinforcing materials and their interaction</li> <li>- Development of composite materials</li> <li>- Mechanical and physical properties</li> <li>- Mechanics of Composite Materials</li> <li>- Laminate theory</li> <li>- Test methods</li> <li>- Non destructive testing</li> <li>- Failure mechanisms</li> <li>- Theoretical models for the prediction of properties</li> <li>- Application</li> </ul>
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of	Integrated Production Systems
Тур	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 D	esign / 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	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: Developmen	nt 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ca. 10 Seiten und Diskussion
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	
	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	
Cycle	
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Content	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



Course L1514: Lightweight	Construction with Fibre Reinforced Rolymers - Structural Mechanics
	Lecture
Hrs/wk	
CP	
	I = Independent Study Time 32, Study Time in Lecture 28
	Mündliche Prüfung
Examination duration and	
scale	130 min
Lecturer	Dr. Marco Schürg
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
Literature	current edition.  Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London
	<ul> <li>current edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> <li>Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.</li> </ul>



qvT	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
xamination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineer 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resulta 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-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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffn 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Y current edition.</li> </ul>
	<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lonc current edition.</li> </ul>



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

Course L0950: Mechanisms	s, 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	190 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

Course L0820: Aircraft Des	sign 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	L12() Minuten	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	WiSe	
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation	
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"	



Course L0834: Aircraft Design I		
Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA electrochemical etching, anisotropic etching with KOHTMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process;</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: spinning current Hall sensor and magneto-transistor magnetoresistive sensors; magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010
	G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



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

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



Course L1434: Renewable Energy		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and scale	160 Minuten	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE/EN	
Cycle	SoSe	
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer.  Possible tasks in the field of renewable energies are:  Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy	
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>	

Course I 1120, Civ Ciama	
Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical De	esign	
	Lecture	
Hrs/wk		
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and scale	(Hausarbeit)	
Lecturer	Prof. Werner Granzeier	
Language		
Cycle	SoSe	
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>	
	Literatur über technisches Produktdesign  Technisches Rendering und Präsentation  Zeichnen und perspektivisches Entwerfen	
	Literaturhinweise	
	What is Product Design ?	
	Laura Slack	
	RotoVision Schweiz 2006	
	Product Design Now	
	Design and Scetches	
	CollinsDesign and maomao publications Spanien 2006	
	Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques	
	for Designers, Illustrators and Architects,	
	Watson, Guptil Puplications,a division of Billboard Publications Inc.,	
	New York 1983	
	Creative Techniques	



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

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

TUHH

Course L0379: Ceramics To	echnology	
Тур	Lecture	
Hrs/wk		
СР	3	
Workload in Hours	Independent Study Time 62,	Study Time in Lecture 28
Examination Form	Klausur	
Examination duration and scale	90 Minuten	
Lecturer	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
<b>.</b>		3. Powder fabrication
Content		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	o Ceramics", John Wiley & Sons, New York, 1975
Literature	ASM Engineering Materials	Handbook Vol.4 "Ceramics and Glasses", 1991
	D.W. Richerson, "Modern Ceramic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung	

Course L0949: Materials Testing			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	190 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		
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	Typ Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	f Aircraft Systems	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>	
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>	



Module M0563: Robo	otics			
Courses				
Title		Тур	Hrs/wk	СР
Robotics: Modelling and Control		Lecture	3	3
Robotics: Modelling and Control	(L1305)	Recitation Section (small)	2	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	e following learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties robotics.	of robots and solution appro	aches for mu	Iltiple problems in
	Students are able to derive and solve equations of moti	on for various manipulators.		
Skills	Students can generate trajectories in various coordinate systems.			
	Students can design linear and partially nonlinear contr	rollers for robotic manipulator	S.	
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed	- '		
Autonomy	Students are able to recognize and improve knowledge deficits independently.  With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	I			
Credit points				
-	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 Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Production Management: Specialisation Production Technology: 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 Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			



Course L0168: Robotics: Modelling and Control		
Тур	Lecture	
Hrs/wk	3	
СР	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: Fligh	t Physics			
Courses				
Title		Тур	Hrs/wk	СР
Aerodynamics and Flight Mecha	anics I (L0727)	Lecture	3	3
Flight Mechanics II (L0730)		Lecture	2	2
Flight Mechanics II (L0731)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
	Basic knowledge in:			
	Mathematics			
Recommended Previous	Mechanics			
Knowledge	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
Knowledge				
Skills				
Personal Competence				
Social Competence	İ			
Autonomy	İ			
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	L120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Product Development Materials and Product	Specialisation II. Aviation Systems: Eleion: Specialisation Product Developmion: Specialisation Production: Electivion: Specialisation Materials: Elective isation Aircraft Systems Engineering: I	ent: Elective Compulsory Compulsory Elective Compu	ompulsory

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



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

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



Module M0815: Prod	uct Planning			
Module Moors. Prod	luct Flamming			
Courses				
		T	Llue hade	0.0
Title		<b>Typ</b> Project-/problem-based	Hrs/wk	CP
Product Planning (L0851)		Learning	3	3
Product Planning Seminar (L08	53)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Cornelius Herstatt			
Admission Requirements	None			
Recommended Previous Knowledge	Good basic-knowledge of Business Administration			
	After taking part successfully, students have reached th	e following learning results		
Professional Competence		<b>y y</b>		
	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 instruments			
Personal Competence				
Social Competence	Interact within a team     Raise awareness for globabl issues			
Autonomy	<ul> <li>Gain access to knowledge sources</li> <li>Interpret complex cases</li> <li>Develop presentation skills</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 minutes			
Assignment for the Following Curricula	' '	ttion I. Electives Manageme ion Management: Elective ( alisation Product Developm alisation Production: Electiv alisation Materials: Elective oduct Development and Pro	Compulsory ent: Elective Co e Compulsory Compulsory duction: Electiv	ompulsory



Course L0851: Product Plan	nning
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
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

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



Module M0830: Envi	ronmental Protection and Management			
Courses				
Title Integrated Pollution Control (L0502) Health, Safety and Environmental Management (L0387) Health, Safety and Environmental Management (L0388)		Typ Lecture Lecture Recitation Section (small)	Hrs/wk 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	'			
Recommended Previous Knowledge	Good knowledge in Technologies for Environme     Good knowledge of the relevant Environmental L     Basic knowledge of instruments for Environmental	egislation	integrated so	lutions)
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 ecoefficiency 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 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 Lecture 70			
Credit points	6			
	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula				



Course L0502: Integrated P	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, Safe	ty 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	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)  Exercises can be downloaded from StudIP

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



Module M0962: Susta	ainability and Risk Manager	ment		
Courses				
Title Safety, Reliability and Risk Asse Environment and Sustainability (	,	<b>Typ</b> Seminar Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	·			
Recommended Previous Knowledge	Inone			
Educational Objectives	After taking part successfully, students	s have reached the following learning resu	ilts	
	Students are able to describe single as well as environmental and sustain  • basics in safety and reliability • safety and reliability analysis in risk assessment • Production and usage of bio-ce energy production and supply • sustainable product design  Students are able apply interdiscipling They can evaluate the effort and costs	of technical facilities methods char	essment and susta	inability reporting.
Personal Competence Social Competence Autonomy	Students can gain knowledge of t Furthermore, they can define targets sustainability concepts accordance w	the subject area from given sources as for new application or research-oriented with the potential social, economic and culture.	duties in for risk	•
	Independent Study Time 124, Study T	Time in Lecture 56		
Credit points				
Examination Examination duration and scale	l Flaboration and presentation (45 min	uutes in groups)		
	Product Development, Materials and Product Development, Materials and	neering: Specialisation II. Civil Engineering Production: Specialisation Product Develo Production: Specialisation Production: Ele Production: Specialisation Materials: Elect	pment: Elective Co	

Course L1145: Safety, Relia	ability and Risk Assessment
Тур	Seminar
Hrs/wk	2
СР	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	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>



Course L0319: Environmen	t 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.



Module M1024: Meth	ods of Integrated Product Developr	nent		
	,			
Courses				
Title		Тур	Hrs/wk	СР
Integrated Product Developmen	nt II (L1254)	Lecture	3	3
Integrated Product Developmen	nt II (L1255)	Project-/problem-based Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	I			
Recommended Previous Knowledge	Basic knowledge of Integrated product developm	nent and applying CAE systems		
Educational Objectives	After taking part successfully, students have reac	hed the following learning results	;	
Professional Competence				
	After passing the module students are able to:			
Knowledge	explain technical terms of design method     describe essential elements of constructio     describe current problems and the current	on management,	roduct developr	nent.
Skills	After passing the module students are able to:  • select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions,  • solve product development problems with the assistance of a workshop based approach,  • choose and execute appropriate moderation techniques.			
Personal Competence				
Social Competence	After passing the module students are able to:  • prepare and lead team meetings and mod • work in teams on complex tasks, • represent problems and solutions and ad	·		
Autonomy	After passing the module students are able to:  • give a structured feedback and accept a c  • implement the accepted feedback autono			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 Minuten			
	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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			



	roduct Development II
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
	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
	<ul> <li>Modularization methods,</li> <li>Design catalogs,</li> </ul>
	Adapted QFD matrix,
	Systematic material selection,
	Assembly oriented design,
	Construction management
Content	,
	Patents, patent rights, patent monitoring
	Project management (cost, time, quality) and escalation principles,
	Development management for mechatronics,  Tarketical Order Management
	Technical Supply Chain Management.
	Exercise (PBL)
	In the exercise the content presented in the lecture "Integrated Product Development II" and methods of product development and design management will be enhanced.
	Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currently existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussions and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	<ul> <li>Andreasen, M.M., Design for Assembly, Berlin, Springer 1985.</li> <li>Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007.</li> <li>Beckmann, H.: Supply Chain Management, Berlin, Springer 2004.</li> <li>Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte Berater und Trainer, Weinheim, Beltz 2007.</li> <li>Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.</li> </ul>

 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	
СР	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	



Madala Micoo Buad				
Module M1002: Prod	uction and Logistics Managemer	nt		
Courses				
Title Operative Production and Logis	tics Management (L1198)	Typ Lecture	Hrs/wk	<b>CP</b> 2
Strategic Production and Logisti	ics Management (L1089)	Project-/problem-based Learning	3	4
Module Responsible	Prof. Wolfgang Kersten			
Admission Requirements	None			
Recommended Previous Knowledge	Introduction to Business and Management  The previous knowledge, that is necessary learning. Log-in and additional information w	• •		accessable via e
Educational Objectives	After taking part successfully, students have r	reached the following learning results		
Professional Competence				
Knowledge	Students will be able to differentiate between strategic and oper to describe the areas of production and lo understand the difference between traditio to describe and explain the actual challe context.	gistics management, onal and new concepts of production p	lanning and co	
Skills	Based on the acquired knowledge students are capable of  - Applying methods of production and logistics management in an international context,  - Selecting sufficient methods of production and logistics management to solve practical problems,  - Selecting appropriate methods of production and logistics management also for non-standardized problems,  - Making a holistic assessment of areas of decision in production and logistics management and releval influence factors.			
Personal Competence				
Social Competence	After completion of the module students can lead discussions and team sessions, arrive at work results in groups and docun develop joint solutions in mixed teams and present solutions to specialists and develor After completion of the module students can	d present them to others,		
Autonomy	- assess possible consequences of their professional activity,			
	<ul> <li>- define tasks independently, acquire the requisite knowledge and use suitable means of implementation,</li> <li>- define and carry out research tasks bearing in mind possible societal consequences.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in I	Lecture 70		
Credit points	6			
<u> </u>	Written exam			
Examination duration and scale	1120 min			
Assignment for the Following Curricula	I Product Development, Materials and Product	ualification: Compulsory tion: Specialisation Product Developm tion: Specialisation Production: Electiv	e Compulsory	ompulsory



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



rse L1089: Strategic Pr	roduction and Logistics Management		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР	4		
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Wolfgang Kersten, Dr. Meike Schröder		
Language			
Cycle	Identification of the scope of production, operations and logistics management     Understanding of actual challenges concerning production and logistics strategy     Understanding operations as a competitive weapon     Identification and design of the main elements of an operations strategy (level of vertical integration technology strategy, location strategy, capacity strategy) of a company     Evaluation of operation strategies of different companies and industrial sectors     In depth discussion of methods and concepts of production and logistics management     In depth discussion of lean management: Main goals and measures of lean management and lead production concepts, impact of lean management on production strategy     Presentation and discussion of current research topics in the field of production and logistics management Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solv skills as well as presentation skills		
Literature	Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft – Einführung in das industrielle Produktionsmana. 12. Auflage, München: Oldenbourg.  Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft – eine Einführung für Wirtschaftsingenieure, 2. // Berlin Heidelberg [u.a.]: Springer.  Heizer, J./Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.  Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.  Porter, M. E. (2008): Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, 11. // Frankfurt/Main [u.a.]: Campus-Verlag.  Slack, N./ Lewis, M.(2002): Operations Strategy, Harlow u.a.  Swink, M./ Melnyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New Yow Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Computers in Industr 79-88  Womack, J./ Jones, D./ Roos, D. (1990): The Machine that changed the world; New York.  Zahn, E. /Schmid, U. (1996): Grundlagen und operatives Produktionsmanagement, Stuttgart: Lucius & Luciu Zäpfel, G.(2000): Produktionswirtschaft: Strategisches Produktions-Management, 2. Aufl., München u.a.		



Module M1025: Fluid	ics			
Courses				
Title		Тур	Hrs/wk	CP
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Project-/problem-based Learning	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, ela and engineering design	stostatics, hydrostatics, kinematic	s and kinetics	), fluid mechanics,
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
	After passing the module students are able to			
Knowledge	<ul> <li>explain structures and functionalities of hyde</li> <li>explain the interaction of hydraulic compon</li> <li>explain open and closed loop control of hyde</li> <li>describe functioning and applications of locentrifugal pumps and aggregates in plant</li> </ul>	nents in hydraulic systems, draulic systems, nydrodynamic torque converters,	·	
Skills	After passing the module students are able to  analyse and assess hydraulic and pneuma design and dimension hydraulic systems fo perform numerical simulations of hydraulic select and adapt pump characteristic curve dimension hydrodynamic torque converter	or mechanical applications, systems based on abstract proble s for hydraulic systems		
Personal Competence	After passing the module students are able to			
Social Competence	After passing the module students are able to     discuss and present functional context in g     organise teamwork autonomously.	roups,		
Autonomy	After passing the module students are able to  obtain necessary knowledge for the simula	ition.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	· · · · · · · · · · · · · · · · · · ·			
•	Written exam			
Examination duration and scale	90			
Assignment for the	International Management and Engineering: Specinternational Management and Engineering: Specinternational Management and Engineering: Specinternational Management and Engineering: Specialisation: Special Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Technical Company of the Management and Engineering: Specialisation of the Management and Engineering of the Management and Engineering of the Management and Engineering of the Management an	pecialisation II. Product Develop Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective on Product Development and Product Development and Product Development and Product	oment and Prent: Compulso e Compulsory Compulsory duction: Electiv	oduction: Elective



Course L1256: Fluidics			
	Lecture		
Hrs/wk	2		
СР			
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Dieter Krause		
Language			
Cycle			
Content	Lecture  Hydrostatics		
	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		
	Qetting 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	<ul> <li>Bücher</li> <li>Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011</li> <li>Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006</li> <li>Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006</li> <li>Beitz, W., Grote, KH.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage</li> </ul>		

Skript zur Vorlesung



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

ourse L1257: Fluidics	
Recitation Section (large)	
1	
1	
Independent Study Time 16, Study Time in Lecture 14	
Prof. Dieter Krause	
DE	
WiSe	
See interlocking course	
See interlocking course	



Module M1155: Aircr	raft Cabin Systems			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	<u></u>			
Recommended Previous Knowledge	Basic knowledge in:  • Mathematics  • Mechanics  • Thermodynamics  • Electrical Engineering  • Control Systems			
Educational Objectives	After taking part successfully, students have reached the	e 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 discuss thei	r ideas with experts		
Autonomy	Students are able to: • Reflect the contents of lectures and expert presentatio	ns self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 Minutes			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Electi Aircraft Systems Engineering: Core qualification: Comp International Management and Engineering: Specialisa Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Theoretical Mechanical Engineering: Specialisation Air Theoretical Mechanical Engineering: Technical Completed	ulsory tion II. Aviation Systems: Ele alisation Product Developme alisation Production: Elective alisation Materials: Elective C craft Systems Engineering: E	nt: Elective Compulsory Compulsory lective Comp	ompulsory



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

Course L1546: Aircraft Cabin Systems	
Тур	Recitation Section (large)
Hrs/wk	1
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 M1342: Poly	mers			
Courses				
Title Structure and Properties of Poly Processing and design with poly		<b>Typ</b> Lecture Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
	<u> </u>	Loctoro		3
Module Responsible Admission Requirements				
Recommended Previous Knowledge	Basics: chemistry / physics / material science			
Educational Objectives	After taking part successfully, students have rea	ched the following learning re	sults	
Professional Competence				
	Students can use the knowledge of plastics	and define the necessary te	sting and analysis.	
Knowledge	They can explain the complex relationships s	structure-property relationshi	p and	
Miowieuge	the interactions of chemical structure of t sustainability, environmental protection). Students are capable of	he polymers, including to	explain neighborin	g contexts (e.g.
- using standardized calculation methods in a given context to mechanical properties (modulus <i>Skills</i> )		ulus, strength) to		
	- For mechanical recycling problems selectir resistance.	g appropriate solutions and	sizing example Sti	fness, corrosion
Personal Competence				
	Students can,			
Social Competence	- arrive at work results in groups and docume	ent them.		
	- provide appropriate feedback and handle fe Students are able to,	edback on their own perform	ance constructively	<i>'</i> .
	- assess their own strengths and weaknesse	s		
Autonomy	- assess their own state of learning in specific terms and to define further work steps on this basis of by teachers.		his basis guided	
	- assess possible consequences of their professional activity.			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	TRIOMEDICAL Engineering, Specialisation Medical Technology and Control Theory, Elective Compilisory			



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	
	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	
Literature	Emonatement organic from collective from the c	

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: Te Regulations)	chnical Complementary Course for PEPMS (according to Subject Specific
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



## **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: Aircr	raft Svetame I			
Wodule Wo703. All Cl	ant Systems i			
Courses				
Title		Tun	Hrs/wk	СР
Aircraft Systems I (L0735)		<b>Typ</b> Lecture	3	4
Aircraft Systems I (L0739)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Ihermodynamics     Electrical Engineering     Hydraulics			
	Control Systems			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence	•			
Knowledge	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 system Design high-lift systems of aircrafts Analyze the thermodynamic behaviour of air			
Personal Competence				
i ordenar dempeterio	Students are able to:			
Social Competence	Porform system decign in groups and process	nt and discuss results		
Autonomy	Students are able to:  • Reflect the contents of lectures autonomousl	у		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	<u> </u>			
	Written exam			
Examination duration and scale	1165 Minutes			
-	Energy Systems: Specialisation Energy Systems: El Aircraft Systems Engineering: Core qualification: Co International Management and Engineering: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Cor	Impulsory Ilisation II. Aviation Systems: Electerialisation Product Development Development Production: Elective Production: Elective Paircraft Systems Engineering: Elective Paircraft Systems Engineering: Elective Paircraft Systems Engineering: Elective Paircraft Systems Engineering:	ent: Elective Co e Compulsory Compulsory Elective Comp	ompulsory



Course L0735: Aircraft Systems I		
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	WiSe	
Content	<ul> <li>Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power)</li> <li>Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis)</li> <li>High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices)</li> <li>Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)</li> <li>De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)</li> </ul>	
Literature	<ul> <li>Moir, Seabridge: Aircraft Systems</li> <li>Green: Aircraft Hydraulic Systems</li> <li>Torenbek: Synthesis of Subsonic Airplane Design</li> <li>SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes</li> </ul>	

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



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

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Project-/problem-based	3	3
		Learning	-	
Ergonomics (L0653)		Lecture	2	3
Structure and Properties of Polymers (L0389) Structure and Properties of Compositor (L0513)		Lecture	2	3 3
Structure and Properties of Composites (L0513)		Lecture Project-/problem-based	2	3
Elements of Integrated Production Systems (L0927)		Learning	2	3
Emotional Design / User Center	ed Product Development (L1703)	Seminar	2	2
Development Management for M		Lecture	2	3
·	oilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
atigue & Damage Tolerance (L	0310)	Lecture	2	3
Joining of Polymer-Metal Lightw	eight Structures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightw	eight Structures (L0501)	Practical Course	1	1
Design with Polymers and Com	posites (L0057)	Lecture	2	3
ightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	2
ightweight Construction with Fi	bre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
ightweight Design Practical Co	urse (L1258)	Project-/problem-based	3	3
		Learning		
	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	plications (LU514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)	04)	Recitation Section (large)	1	1
Microsystems Technology (L07	<b>∠</b> 4)	Lecture	2	4
Productivity Management (L092	8)	Project-/problem-based Learning	2	2
Productivity Management (L093	1)	Recitation Section (small)	1	1
Feedback Control in Medical Te		Lecture	2	3
Renewable Energy (L0313)	ormology (20001)	Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Six Sigma (L1130)		Lecture	2	3
System Analysis in Air Transpo	rtation (L0855)	Lecture	3	3
Fechnical Design (L1513)	,	Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynam	ics (L0176)	Lecture	2	2
Reliability in Engineering Dynam	ics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)		Lecture	2	3
Module Responsible	Prof Dieter Krause			
Admission Requirements  Only one of the modules "Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)" carbon be selected.				
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence  Knowledge	Students are able to express their extended knowledge and discuss the connection of different special fields			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence				
Social Competence	-			
Autonomy				
Workload in Hours	Depends on choice of courses			
	<u> </u>			
Credit points	,			
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				



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		
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
	Mündliche Prüfung
Examination duration and scale	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0389: Structure and Properties of Polymers	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag



Course L0513: Structure and Properties of Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	WiSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L0927: Elements of	Integrated Production Systems
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
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 Iernen: 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.



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

Course L1512: Developmen	nt Management for Mechatronics
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
<b>Examination Form</b>	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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Optimization and Probabilistic Approaches in Structural Analysis		
Тур	Seminar	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and scale	ICA 10 Selten lind Disklission	
Lecturer	Prof. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content		
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.	

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	
Cycle	
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Content	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with Polymers and Composites	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag



Course L1514: Lightweight	Construction with Fibre Reinforced Rolymers - Structural Mechanics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Marco Schürg
Language	DE
Cycle	WiSe
	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
Literature	, , , , , , , , , , , , , , , , , , ,
	<ul> <li>current edition.</li> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, London current edition.</li> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition.</li> </ul>
	Mittelstedt, C., Becker, W., "Strukturmechanik ebener Laminate", aktuelle Auflage.



qvT	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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 resultar 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-W 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; Exatranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffned 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	current edition.  • Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition



Course L1258: Lightweight	Design Practical Course
Тур	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	egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)     egetting of material properties based on sample tests     egetting of the structure in the composite lab     egetting of the developed structure     egetting of the developed structure     egetting of the developed structure     egetting of the developed structure     egetting of the developed structure     egetting of the developed structure     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as well as lightweight design     egetting familiar with fibre reinforced plastics as
Literature	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

	s, 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

O 1.0000 Al (1.D	
Course L0820: Aircraft Des	
	Lecture
Hrs/wk	
СР	2
	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	L12() Minuten
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process  1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design"  D.P. Raymer: "Aircraft Design - A Conceptual Approach"  J.P. Fielding: "Intorduction to Aircraft Design"  Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"



Course L0834: Aircraft Design I	
Typ 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: Microsyster	ns Technology
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques; (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>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)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: rellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, calm</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0664: Feedback Control in Medical Technology	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	
Lecturer	Ulf Pilz, Prof. Olaf Simanski
Language	DE
Cycle	SoSe
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.
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 I	Energy		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form			
Examination duration and scale	90 Minuten		
Lecturer	Prof. Martin Kaltschmitt		
Language	DE/EN		
Cycle	SoSe		
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>		
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>		



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

Cauras I 1120, Civ Ciama	
Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008  Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996  Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical D	esign
	Lecture
Hrs/wk	
CP	
	Independent Study Time 62, Study Time in Lecture 28
Examination duration and	Schriftliche Ausarbeitung
scale	(Hausarbeit)
	Prof. Werner Granzeier
Language	
Cycle	Sose
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>
	Literatur über technisches Produktdesign Technisches Rendering und Präsentation Zeichnen und perspektivisches Entwerfen Literaturhinweise
	What is Product Design ?
	Laura Slack
	Roto Vision 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
	ro (a)



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH

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

Course L0949: Materials Te	esting		
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and scale	190 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			
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	Typ Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	ecture	
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	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>	
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>	

Courses



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

Courses				
Title		Тур	Hrs/wk	CP
Applied Automation (L1592)		Project-/problem-based	3	3
		Learning		
Ergonomics (L0653) Structure and Proporties of Polymers (L0389)		Lecture	2	3
Structure and Properties of Polymers (L0389) Structure and Properties of Composites (L0513)		Lecture Lecture	2 2	3 3
		Project-/problem-based		
Elements of Integrated Production Systems (L0927)		Learning	2	3
Emotional Design / User Cente	red Product Development (L1703)	Seminar	2	2
Development Management for	Mechatronics (L1512)	Lecture	2	3
= :	bilistic Approaches in Structural Analysis (L1814)	Seminar	3	3
Fatigue & Damage Tolerance (		Lecture	2	3
Joining of Polymer-Metal Lightv	-	Lecture	2	2
Joining of Polymer-Metal Lightv	-	Practical Course	1 2	1 3
Design with Polymers and Com	ibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture Lecture	2	2
= =	ibre Reinforced Rolymers - Structural Mechanics (L1515)	Recitation Section (large)	1	1
		Project-/problem-based		
Lightweight Design Practical Co	ourse (L1258)	Learning	3	3
Mechanisms, Systems and Pro	cesses of Materials Testing (L0950)	Lecture	2	2
Metallic Materials for Aircraft Ap	oplications (L0514)	Lecture	2	3
Aircraft Design I (L0820)		Lecture	2	2
Aircraft Design I (L0834)		Recitation Section (large)	1	1
Microsystems Technology (L0	724)	Lecture	2	4
Productivity Management (L09)	28)	Project-/problem-based	2	2
		Learning		4
Productivity Management (L09)		Recitation Section (small)	1	1
Feedback Control in Medical To	echnology (LU664)	Lecture	2 2	3
Renewable Energy (L0313)		Lecture	1	2 1
Renewable Energy (L1434)		Recitation Section (small) Lecture	2	3
Six Sigma (L1130)	ortation (LOSES)		3	3
System Analysis in Air Transpo Technical Design (L1513)	irtation (Looss)	Lecture Lecture	2	3
Ceramics Technology (L0379)		Lecture	2	3
Materials Testing (L0949)		Lecture	2	2
Reliability in Engineering Dynan	nics (I 0176)	Lecture	2	2
Reliability in Engineering Dynan		Recitation Section (small)	1	2
Reliability of Aircraft Systems (		Lecture	2	3
	, 1			-
Module Responsible	1	I December of the Material Code		- Para / Albana - Para
Admission Requirements	Only one of the modules "Selected Topics of Product A: 12 CP)" or "Selected Topics of Product Developm can be selected.			
Recommended Previous Knowledge	INone			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence		*		
Knowledge	Students are able to express their extended knowledge and discuss the connection of different special fields			
Skills	<ul> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>			
Personal Competence Social Competence				
Autonomy	Students are able to develop their knowledge	and skills by autonomous elec	ction of courses	S.
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		ompulsory		
	I round Development, Materials and Production: Spe	oransation Materials: Elective	Compuisory	



Course L1592: Applied Automation		
	Project-/problem-based Learning	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
<b>Examination Form</b>	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	Course L0653: Ergonomics	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
	Mündliche Prüfung	
Examination duration and scale	30 Minuten	
Lecturer	Dr. Armin Bossemeyer	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L0389: Structure ar	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	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Dr. Hans Wittich	
Language	DE	
Cycle	WiSe	
Content		
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag	



Course L0513: Structure ar	ourse L0513: Structure and Properties of Composites	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	EN	
Cycle	WiSe	
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application	
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York	

Course L0927: Elements of	Integrated Production Systems
Тур	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 De	esign / 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	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: Developmen	nt 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	L30 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	<ul> <li>Bender: Embedded Systems - qualitätsorientierte Entwicklung</li> <li>Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit</li> <li>Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen</li> <li>Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung</li> <li>Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden</li> <li>Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung</li> <li>VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme</li> </ul>



Course L1814: Design Option	ourse L1814: Design Optimization and Probabilistic Approaches in Structural Analysis	
Тур	Seminar	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and scale	ICA 10 Selfen und Diskussion	
Lecturer	Prof. Benedikt Kriegesmann	
Language	DE	
Cycle	SoSe	
Content		
Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.	

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



Course L0500: Joining of Po	olymer-Metal Lightweight Structures
	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio de Traglia Amancio Filho
Language	EN
Cycle	WiSe
	Recommended Previous Knowledge:
	Fundamentals of Materials Science and Engineering
	Basic Knowledge of Science and Technology of Welding and Joining
	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:
	Theoretical Lectures:
	- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology
	- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics
Content	- Mechanical Fastening of Polymer-Metal Hybrid Structures
Content	- Adhesive Bonding of Polymer-Metal Hybrid Structures
	- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures
	- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)
	- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)
	- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Learning Outcomes:
	After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>Lecture Notes and selected papers</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>



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

Course L0057: Design with	ourse L0057: Design with Polymers and Composites	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form		
Examination duration and scale	90 Minuten	
Lecturer	Prof. Bodo Fiedler	
Language	DE	
Cycle	WiSe	
Content	Designing with Polymers: Materials Selection; Structural Design; Dimensioning Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples	
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag	



Tvp	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Mündliche Prüfung
xamination duration and scale	30 min
Lecturer	Dr. Marco Schürg
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; Engineer 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resulta 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-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; Extranscendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffer 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	<ul> <li>Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.</li> <li>Timoshenko, S.P., Gere, J.M., "Theory of elastic stability", McGraw-Hill Book Company, Inc., New Y current edition.</li> </ul>
	<ul> <li>Turvey, G.J., Marshall, I.H., "Buckling and postbuckling of composite plates", Chapman and Hall, Lond current edition.</li> </ul>
	<ul> <li>Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition</li> </ul>



dvT	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	130 min
Lecturer	Dr. Marco Schürg
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; Engineeri 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 lay
	Classical Laminate Plate Theory
	Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultar 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-V 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; Ex transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffned 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
	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage.</li> <li>Reddy, J.N., "Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et current edition.</li> </ul>
Literature	Jones, R.M., "Mechanics of Composite Materials", Scripta Book Co., Washington, current edition.
	current edition.  • Herakovich, C.T., "Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition



Course L1258: Lightweight	Design Practical Course
3 5	Project-/problem-based Learning
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE/EN
Cycle	SoSe
Content	Pevelopment 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	<ul> <li>Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005.</li> <li>Puck, A., "Festigkeitsanalsyse von Faser-Matrix-Laminaten", Hanser, München, Wien, 1996.</li> <li>R&amp;G, "Handbuch Faserverbundwerkstoffe", Waldenbuch, 2009.</li> <li>VDI 2014 "Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund"</li> <li>Ehrenstein, G. W., "Faserverbundkunststoffe", Hanser, München, 2006.</li> <li>Klein, B., "Leichtbau-Konstruktion", Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.</li> <li>Wiedemann, J., "Leichtbau Band 2: Konstruktion", Springer, Berlin, Heidelberg, 1986.</li> <li>Backmann, B.F., "Composite Structures, Design, Safety and Innovation", Oxford (UK), Elsevier, 2005.</li> <li>Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	I 9() 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	<ul> <li>E. Macherauch: Praktikum in Werkstoffkunde, Vieweg</li> <li>G. E. Dieter: Mechanical Metallurgy, McGraw-Hill</li> <li>R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg</li> <li>R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg</li> </ul>



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

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



Course L0834: Aircraft Design I		
Typ 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: Microsysten	ns Technology
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	<ul> <li>Introduction (historical view, scientific and economic relevance, scaling laws)</li> <li>Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting)</li> <li>Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)</li> <li>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, dy etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)</li> <li>Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SUB, rapid prototyping)</li> <li>Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)</li> <li>Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)</li> <li>Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)</li> <li>Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, capacitive problems,</li></ul>
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002  N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009  T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010  G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008



Course L0928: Productivity	Management
Тур	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	190 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	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	
Examination duration and scale	90 Minuten
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Course L0664: Feedback Control in Medical Technology		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Ulf Pilz, Prof. Olaf Simanski	
Language	DE	
Cycle	SoSe	
Content	Taking an engineering point of view, the lecture is structured as follows.  Introduction to the topic with selected examples Physiology - introduction and overview Regeneration of functions of the cardiovascular system Regeneration of the respiratory functions Closed loop control in anesthesia regeneration of kidney and liver functions regeneration of motorize function/ rehabilitation engineering navigation systems and robotic in medicine  The lecture will use knowledge from modeling, simulation and controller design and MATLAB and SIMULINK will be used.	
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	
	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and scale	90 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>introduction</li> <li>solar energy for heat and power generation</li> <li>wind power for electricity generation</li> <li>hydropower for electricity generation</li> <li>ocean energy for electricity generation</li> <li>geothermal energy for heat and electricity generation</li> </ul>
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>



Course L1434: Renewable Energy		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and scale	160 Minuten	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE/EN	
Cycle	SoSe	
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer.  Possible tasks in the field of renewable energies are:  Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy	
Literature	<ul> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>	

0	
Course L1130: Six Sigma	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	190 Minuten
Lecturer	Prof. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Introduction and structuring</li> <li>Basic terms of quality management</li> <li>Measuring and inspection equipment</li> <li>Tools of quality management: FMEA, QFD, FTA, etc.</li> <li>Quality management methodology Six Sigma, DMAIC</li> </ul>
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008



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

Course L1513: Technical Design			
	Lecture		
Hrs/wk			
CP			
	Independent Study Time 62, Study Time in Lecture 28 Schriftliche Ausarbeitung		
Examination duration and	-		
scale	(Hausarbeit)		
	Prof. Werner Granzeier		
Language			
Cycle	SoSe		
Content	<ul> <li>Basics with analysis, concept, proposal drawings and sketches</li> <li>Samples from practice of technical industrial design</li> <li>Product concept with new ideas and package</li> <li>ID proposal with structural concept and external product ergonomics</li> <li>Visualisation and presentation of the overall concept</li> <li>Realization as individual case studies</li> </ul>		
	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		
	[360]		



DRAWING

Barons Educational Series

ISBN-13:978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

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

TUHH Hambure University of Technolog

Occurs LOCTO Occupation Technology			
Course L0379: Ceramics Technology			
Hrs/wk	Lecture		
CP	<u>!</u>		
	Independent Study Time 62,	Study Time in Lecture 28	
Examination Form	<u>                                       </u>		
Examination duration and scale	190 Minuten		
Lecturer	Dr. Rolf Janßen		
Language	DE/EN		
Cycle	WiSe		
	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. "powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.		
	Content:	1. Introduction	
	Inhalt:	2. Raw materials	
		3. Powder fabrication	
Content		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	o Ceramics", John Wiley & Sons, New York, 1975	
	ASM Engineering Materials I	Handbook Vol.4 "Ceramics and Glasses", 1991	
Literature	D.W. Richerson, "Modern Ce	eramic Engineering", Marcel Decker, New York, 1992	
	Skript zur Vorlesung		

Course L0949: Materials Te	sting		
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	190 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		
	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			
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		
Typ Recitation Section (small)		
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Examination Form		
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	f 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	<ul> <li>Functions of reliability and safety (regulations, certification requirements)</li> <li>Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment)</li> <li>Reliability analysis of electrical and mechanical systems</li> </ul>	
Literature	<ul> <li>CS 25.1309</li> <li>SAE ARP 4754</li> <li>SAE ARP 4761</li> </ul>	



Module M1193: Cabi	n Systems Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Computer and communication technology in cabin electronics and avionics (L1557) Computer and communication technology in cabin electronics and avionics (L1558)		Lecture Recitation Section (sma		2 1
Model-Based Systems Enginee	ring (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	ned the following learning resu	ults	
Professional Competence				
Knowledge	Students are able to:  • describe the structure and operation of computer architectures  • explain the structure and operation of digital communication Networks  • explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN)  • understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software based cabin systems			
Skills	Students are able to:  • understand, operate and maintain a Minicomputer  • build up a network communication and communicate with other 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				
·	Students are able to: • elaborate partial results and merge with others to	o 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 84			
Credit points	6			
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			



Course L1557: Computer and communication technology in cabin electronics and avionics		
Тур	Lecture	
Hrs/wk	2	
СР	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	<ul> <li>- Skript zur Vorlesung</li> <li>- Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003</li> <li>- Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004</li> <li>- Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006</li> </ul>	



Course L1558: Computer a	nd 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-Base	d 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	



Modulo M0511: Floot	ricity Generation from Wind an	d Hydro Power			
Module Most I. Elect	incity Generation from wind an	a nyaio Powei			
Соливоо					
Courses					
Title		Тур	Hrs/wk	CP	
Renewable Energy Projects in E	Emerged Markets (L0014)	Project Seminar	1	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011) Wind Energy Use - Focus Offsh	ooro (L0012)	Lecture Lecture	2 1	3 1	
	· · ·	Lecture	<u>'</u>		
Module Responsible					
Admission Requirements					
	Module: Technical Thermodynamics I,				
Recommended Previous	Module: Technical Thermodynamics II,				
Knowledge	.,				
	Module: Fundamentals of Fluid Mechanics	5			
Educational Objectives	After taking part successfully, students have	ve reached the following learning resul	ts		
Professional Competence					
	By ending this module students can exp	lain in detail knowledge of wind turbi	nes with a partic	ular focus of wind	
	energy use in offshore conditions and can				
	Furthermore, they are able to describe fu	ndamentally the use of water power t	o generate electr	icity. The students	
l/a ala alaa	reproduce and explain the basic procedur	e in the implementation of renewable	energy projects in	countries outside	
Knowledge	Europe.				
	Through active discussions of various topi	cs within the seminar of the module. st	udents improve th	eir understanding	
	and the application of the theoretical back	•	•		
	Students are able to apply the acquired		•	-	
	evaluate and assess technically the resu energy systems. They can in compare cri	- ·	-	•	
Skills	projects in countries outside Europe with		•		
	on exemplary theoretical projects.	and the state of the same		, ,	
Personal Competence					
Social Competence	Students can discuss scientific tasks subj	et-specificly and multidisciplinary withi	n a seminar.		
codal compotento					
4	Students can independently exploit sour			terial to clear the	
Autonomy	contents of the lecture and to acquire the p	particular knowledge about the subject	area.		
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70			
Credit points	6				
Examination	Written exam				
Examination duration and	0.1				
scale	3 hours written exam				
	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsor	ry .		
	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. Energy and Environmental Engineering: Elective				
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				
	Renewable Energies: Core qualification: Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory  Water and Environmental Engineering: Specialisation Environment: Compulsory				
	Water and Environmental Engineering: Sp.				
	Trace and Environmental Engineening. Sp	ociansation Offices. Liective Compulso	· y		



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



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

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



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



Module M0630: Robo	otics and Navigation in Medicine			
Courses				
Title Robotics and Navigation in Med Robotics and Navigation in Med Robotics and Navigation in Med	icine (L0338)	Typ Lecture Project Seminar Recitation Section (small)	Hrs/wk 2 2	CP 3 2
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>principles of math (algebra, analysis/calculus)</li> <li>principles of programming, e.g., in Java or C++</li> <li>solid R or Matlab skills</li> </ul>			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students can explain kinematics and tracking sys components in details. Systems can be evaluated with Students can assess typical systems regarding design at	respect to collision detection	-	
Skills	The students are able to design and evaluate navigation	systems and robotic systems	s for medical a	pplications.
Personal Competence				·
Social Competence	The students discuss the results of other groups, provide work.	e helpful feedback and can ir	ncoorporate fe	edback into their
Autonomy	The students can reflect their knowledge and document appropriate manner.	the results of their work. The	y can present	the results in an
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineeri Electrical Engineering: Specialisation Medical Technology Computational Science and Engineering: Specialisation International Management and Engineering: Specialisation International Management and Engineering: Specialisation Mechatronics: Specialisation Intelligent Systems and Ro Biomedical Engineering: Specialisation Artificial Organs Biomedical Engineering: Specialisation Implants and Engineering: Specialisation Medical Techno Biomedical Engineering: Specialisation Management and Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Production Mechanical Engineering: Technical Complete Theoretical Mechanical Engineering: Specialisation Bio-	gy: Elective Compulsory Systems Engineering and Ri ion II. Electrical Engineering: botics: Elective Compulsory and Regenerative Medicine: doprostheses: Elective Complogy and Control Theory: Ele id Business Administration: E lisation Product Development lisation Production: Elective Computation Materials: Elective Computation Course: Elective Comentary Course: Elective Elective Elective Elective Elective Elective Elective Elective El	Elective Compulsory ctive Compuls Elective Compute Elective Computer Elective Compulsory compulsory compulsory compulsory	pulsory pulsory ory ulsory npulsory



Course L0335: Robotics an	d Navigation in Medicine
Тур	Lecture
Hrs/wk	2
СР	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	urse L0338: Robotics and Navigation in Medicine		
Тур	Project Seminar		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Alexander Schlaefer		
Language	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
СР	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



Walter-Adding Networks (1190)  Module Responsible   Prof. Thorsten Blacker   2   2    Admission Requirements   2   2    Admission Requirements   2   2    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   2   3    Admission Requirements   3   3    Current developments in informational business activities such as a subdoucting, elitioning, informationalization and obtained in a supply chain management and use in practice, 1 to inclinate in which is possible and supply chain management and use in practice, 1 to inclinate places of network property-right freely and the resource-based view. 1 to liverable places of network property-right freely and the resource-based view. 2   3   3   3   3   3   3   3   3   3	Module M0996: Supp	ly Chain Management			
Title Type Heavier (1.1218) Singley Chain Management (1.1218) Rodule Responsible Prof. Thorsten Blacker  Module Responsible Prof. Thorsten Blacker  Admission Requirements  Recommended Previous Recommended Recom	Courses				
Supply Chain Management (L1218)   Proset-protein-based   S   4			Tyn	Hre/wk	CP
Native Acting Networks (L118)  Module Responsible   Prot. Thoristen Blecker   Lockure   2   2    Admission Requirements   Prot. Thoristen Blecker		10)	••		-
Module Responsibile Prof. Thorsism Blocker  Admission Requirements  Recommended Previous Knowledge  Educational Dispettives   After taking part successfully, students have reached the following learning results  Current developments in informational business activities such as outsourcing, offshoring, internationalization and globalization and emerging markets illustrated by examples from practice.  *Thoroscial Approaches and methods in logistics and supply chain management and use in practice.  *Thoroscial Approaches and methods in logistics and supply chain management and use in practice.  *In dentify fields of decision in SCM.  *Selected approaches to paginar and development of networks.  *Selected approaches to paginar and development of networks.  *Selected approaches to paginar and development of networks.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In understand the functional mechanisms of inter-organizational and international network relationships.  *In additional approaches.  *In understand the functional mechanisms of inter-organizational and international networks of distinction between the total series.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional networks.  *In additional professional		10)	· ·	-	
Recommended Previous Knowledge 100  Educational Objectives After taking part successfully, students have reached the following learning results   Professional Competence Current developments in international business activities such as outsourcing, offshoring, internationalization and obstances of the control of the con			Lecture	2	2
Recommended Provided Rovinedge Educational Objectives A floredge Current developments in international business activities such as outsourcing, oftshoring, international zurious and production approaches and methods in logistics and supply chain management and use in practice.  - Theoretical Approaches and methods in logistics and supply chain management and use in practice Theoretical Approaches and methods in logistics and supply chain management and use in practice Theoretical Approaches and methods in logistics and supply chain management and use in practice Theoretical Approaches in extension in SCMI Peaces for the formation of networks based on various theories from institutional economics (transaction or international methods in logistics and supply chain meaning methods (transaction or international methods) Peaces for the formation of networks and the development of networks For the formation of the functional mechanisms of inter-organizational and international network relationships within networks In understand the functional mechanisms of inter-organizational and international network relationships within networks In catalogories sporturing concepts and explain motives barriers or advantages and disadvantages.  **Nonwindege** Advantages and disadvantages of distincting and outsourcing and to illustrate the distinction between the two terms In the state of the functional mechanisms of inter-organizational and international network relationships with the configuration of logistics networks (distinction and their locations and to describe orbital terms.) - In the interpret phenotypes of production networks In catalogories special wasia logistics including their duties & objectives and to state and describe practice and production and production and special parts networks by the product or production and their locations and to state and describe practice and production and production and production and production and production and production and production and production a	Module Responsible				
Educational Objectives  Professional Competence  Current developments in international business activities such as outsourcing, othshoring, internationalization and globalization and emerging markets illustrated by examples from practice.  - Theoretical Approaches and methods in logistics and supply chair management and use in practice In identity fields of decision in SCM Inacordia in the formation of networks based on various theories from institutional economics (transaction continuor), principal-algent theory, properly-right theory) and the resource-based view Selected approaches to explain the development of networks In illustrate phases of reviews formation In understand the functional mechanisms of inter organizational and international network relationships In understand the functional mechanisms of inter organizational and international network relationships In understand the functional mechanisms of inter organizational and international network relationships In understand the functional mechanisms of international relationships and disadvantages.  Knowledge - Advantages and disadvantages of offshorting and outsourcing and to illustrate the distinction between the functional properties of production networks In categorize relationships between R & D and production and their locations and to describe coherent models In other property phenotypes of production networks In cases trends and challenges in national and international supply chains and logistics networks and the consequences for companies In a cases trends and challenges in national and international supply chains and logistics networks and the consequences for companies In a cases trends and challenges in national and international supply chains and logistics networks and the consequences for companies In a cases trends and challenges in national and international supply chains and to evaluate the suitability of the production of the supplies between R & D and production as well as their locations and	Admission Requirements	no			
Professional Competence Current developments in international business activities such as outsourcing, offshoring, internationalization and globalization and emerging markets illustrated by examples from practice.  **Theoretical Approaches and methods in logistics and supply chain management and use in practice.  **Theoretical Approaches to the formation of networks based on various theories from institutional economics (transaction contect), principal-agent theory, property-right theory) and the resource-based view.  **Selected approaches to explain the development of networks.  **to illustrate phases of network formation.  **to understand the functional mechanisms of inter-organizational and international network relationships.  **to explain and categorize relationships within networks.  **to explain and categorize relationships within networks.  **to explain methods for location finding/evaluation.  **to interpret phenotypes of production networks.  **to explain methods for location finding/evaluation.  **to interpret phenotypes of production networks.  **recognize relationships between R & D and production and their locations and to describe otherent models.  **to solve sub-problems with the configuration of logistics networks (distribution and spare parts networks) by it use of appropriate approaches.  **to categories special waste logistics including their duties & objectives and to state and describe practice examples of good networking.  **to assess trends and challenges in national and international supply chains and logistics networks and the consequences for companies.  **to evaluate, analyse and systematise networks and network relations based on the lecture.  **to availate particular and international and international supply chains and logistics networks and network relations and to evaluate the suitabilist of production and a particular and companies and evaluation and a particular and international and evaluation and evaluate the suitabilist of the case studies and their evaluation and evaluate		no			
Current developments in international business activities such as outsourcing, offshoring, internationalization and globalization and employing markets illustrated by examples from practice.  **Theoretical Approaches and methods in logistics and supply chain management and use in practice.  **To interest fields of decision in SCM.**  **reasons for the formation of networks based on various theories from institutional economics (transaction con theory, property-right theory) and the resource-based view.  **Selected approaches to explain the development of networks.  **to litustrate phases of notworks formation.**  **to transplain and categorize relationships within networks.  **to transplain and categorize relationships within networks.  **to categorize sourcing concepts and explain motives/barriers or advantages and disadvantages.  **Knowledge**  **Knowledge**  **Knowledge**  **to sate criteria/ factors/ parameters that influence production location decisions at the global level (total networs);  **to sate criteria/ factors/ parameters that influence production location decisions at the global level (total networs);  **to sate criteria/ factors/ parameters that influence production location decisions at the global level (total networs);  **to sate criteria/ factors/ parameters that influence production location decisions at the global level (total networs);  **to explain methods for location finding/evaluation.  **to interpret phenotypes of production networks.  **recognize relationships between R & Da and production and their locations and to describe coherent models.  **to evaluate, anayles and systematise networks and network relations based on the lecture.  **to anayles partners and their suitability for co-operation in collaborations and cooperative relations.  **to evaluate, anayles and systematise networks and network relations based on the lecture as well as advantage and disadvantages of cach approach.  **to evaluate intercultural and international relationships based on concepts.  **to anayles partner	Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
to assest trends and challenges in national and international supply chains and logistics networks and the consequences for companies.     io evaluate, anaylse and systematise networks and network relations based on the lecture.     io anaylse partners and their suitability for co-operation in collaborations and cooperative relations.     io select sourcing concepts for specific products / product components based on the lecture as well as advantage and disadvantages of each approach.     io evaluate location decisions for production and R & D based on concepts.  Skills  Skills  Skills  1 to recognize relationships between R & D and production as well as their locations and to evaluate the suitability of specific models for different situations.     io transfer the analyzed concepts to international practices.     io analyse concepts to international practices.     io analyse concepts to international practices.     io analyse concepts to international communication management in logistics.     io design subcontracting, procurement, production and disposal as well as R & D networks to shape,     io plan reorganise efficient and flow-oriented enterprise networks.     io adopt methods of complexity management and risk management in logistics.  Personal Competence  Personal Competence  io evaluate intercultural and international relationships based on discussed case studies.     advance planning and design of network formation and their objectives based on content discussed in the lecture definition of procurement strategies for individual parts using the gained knowledge of procurement networks.     io evaluate intercultural and international relationships based on discussed on the sourcing concepts and competencies, as well as on the findings of the case studies.  Social Competence  io evaluate intercultural and international relationships based on the sourcing concepts and outperficiency and their dependence on R & D.     io make decision of location for production taking into account global contexts, eval	Knowledge	globalization and emerging markets illustrated by Theoretical Approaches and methods in logistic to identify fields of decision in SCM reasons for the formation of networks based of theory, principal-agent theory, property-right theo Selected approaches to explain the developmen to illustrate phases of network formation. to understand the functional mechanisms of inte to explain and categorize relationships within ne to categorize sourcing concepts and explain mo advantages and disadvantages of offshoring terms to state criteria/ factors/ parameters that influencests). to explain methods for location finding/evaluatio to interpret phenotypes of production networks. recognize relationships between R & D and pro to solve sub-problems with the configuration of use of appropriate approaches.	r examples from practice. Is and supply chain management on various theories from institution on various theories from institution on various theories from institution on various theories from institution on various theories from institution on various theories from institution on various theories from institution of networks.  r-organizational and international etworks. tives/ barriers or advantages and and outsourcing and to illustrate on production location decisions on. duction and their locations and to illustrate theories from institution and their locations and to illustrate theories from institution and their locations and to illustrate theories from institution in the control of	and use in practional economics  I network relation disadvantages the distinction at the global leads at t	ent models. networks ) by the
* to evaluate intercultural and international relationships based on discussed case studies.     * advance planning and design of network formation and their objectives based on content discussed in the lecture objectives based on content discussed in the lecture objectives based on content discussed in the lecture objectives based on the sourcing concepts and concepts and concepts of the procurement network (external/internal/modules etc.) based on the sourcing concepts and concepts and concepts and concepts and concepts and concepts and the procurement network (external/internal/modules etc.) based on the sourcing concepts and concepts and concepts and the sourcing concepts and concepts and the case studies.  **To make decision of location for production taking into account global contexts, evaluation methods are buying/selling markets, which were also discussed in the case studies and their dependence on R & D.  **Decision on R & D locations based on the insights gained from case studies / practical examples and the selection of an appropriate model.  **After completing the module students are capable to work independently on the subject of Supply Chambara Management and transfer the acquired knowledge to new problems.  **Workload in Hours** Independent Study Time 110, Study Time in Lecture 70  **Credit points** 6  **Examination** Examination duration and the selection of the procurement networks.  **To make decision of network (external/internal/modules etc.) based on the sourcing concepts and concepts an		consequences for companies.  • to evaluate, anaylse and systematise networks a • to anaylse partners and their suitability for co-op • to select sourcing concepts for specific products and disadvantages of each approach. • to evaluate location decisions for production and • to recognize relationships between R & D and of specific models for different situations. • to transfer the analyzed concepts to internationa • to analyse and evaluate the product developme • to anaylse concepts of Information and commun • to design subcontracting, procurement, producti • to plan reorganise efficient and flow-oriented en	and network relations based on the reration in collaborations and cood product components based on the R & D based on concepts. Production as well as their location as their location practices. In processes, ication management in logistics, on and disposal as well as R & D terprise networks.	ne lecture. perative relatio the lecture as w ons and to eval	ns. vell as advantage uate the suitabilit
* advance planning and design of network formation and their objectives based on content discussed in the lecture * definition of procurement strategies for individual parts using the gained knowledge of procurement networks. * design of the procurement network (external/internal/modules etc.) based on the sourcing concepts and concompetencies, as well as on the findings of the case studies. * to make decision of location for production taking into account global contexts, evaluation methods are buying/selling markets, which were also discussed in the case studies and their dependence on R & D. * Decision on R & D locations based on the insights gained from case studies / practical examples and the selection of an appropriate model.  After completing the module students are capable to work independently on the subject of Supply Chambara Management and transfer the acquired knowledge to new problems.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and 120 min	Personal Competence				
Autonomy Management and transfer the acquired knowledge to new problems.  Workload in Hours Independent Study Time 110, Study Time in Lecture 70  Credit points 6  Examination Written exam  Examination duration and 120 min	Social Competence	<ul> <li>advance planning and design of network formation and their objectives based on content discussed in the lecture</li> <li>definition of procurement strategies for individual parts using the gained knowledge of procurement networks.</li> <li>design of the procurement network (external/internal/modules etc.) based on the sourcing concepts and core competencies, as well as on the findings of the case studies.</li> <li>to make decision of location for production taking into account global contexts, evaluation methods and buying/selling markets, which were also discussed in the case studies and their dependence on R &amp; D.</li> <li>Decision on R &amp; D locations based on the insights gained from case studies / practical examples and the selection</li> </ul>			
Credit points 6 Examination Written exam  Examination duration and 120 min	Autonomy			n the subject	of Supply Chair
Examination Written exam  Examination duration and 120 min	Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Examination duration and 120 min	Credit points	6			
1120 min	Examination	Written exam			
scale	Evamination duration and	100			



## Assignment for the Following Curricula

International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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 L1218: Supply Cha	in 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	<ul> <li>Implementation of the fields of purchasing, operations and sales into the business strategy</li> <li>Transmission of knowledge concerning demand management and distribution logistics</li> <li>Integration of a supply chain game based on the SCOR-model; preparation of the results with modern presentation methods</li> </ul>
Literature	Bowersox, D. J., Closs, D. J. und Cooper, M. B. (2007): Supply chain logistics management, Boston, Mass. [u.a.], McGraw-Hill/Irwin.  Chopra, S. und Meindl, P. (2007): Supply chain management: strategy, planning, and operation, 3 <sup>rd</sup> 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-Addin	ng 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	<ul> <li>Introduction: Overview of current trade flows and development of global business cooperation</li> <li>Networks explanations using neo institutional approaches as a theoretical basis</li> <li>Networks organization and functioning</li> <li>Development stages of networks</li> <li>Presentation of different network types such as supplier, production, disposal and logistics network as well as their respective requirements, peculiarities and characteristics</li> </ul>
Literature	<ul> <li>Ballou, R. Business Logistics/Supply Chain Management, Upper Saddle River 2004.</li> <li>Bellmann, K. (Hrsg.): Kooperations- und Netzwerkmanagement, Berlin 2001.</li> <li>Bretzke, W.R.: Logistische Netzwerke, Berlin Heidelberg 2008.</li> <li>Blecker, Th. / Gemünden, H. G. (Hrsg.): Wertschöpfungsnetzwerke, Berlin 2006.</li> <li>Kaluza, B. / Blecker, Th. (Hrsg.): Produktions- und Logistikmanagement in virtuellen Unternehmen und Unternehmensnetzwerken, Berlin et al. 2000.</li> <li>Sydow, J. / Möllering: Produktion in Netzwerken, Berlin 2009.</li> <li>Willibald A. G. (Hrsg.): Neue Wege in der Automobillogistik, Berlin Heidelberg 2007.</li> </ul>



Module M0764: Aircr	raft Svstems II			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Systems II (L0736)		Lecture	3	4
Aircraft Systems II (L0740)		Recitation Section (large)	2	2
Module Responsible	Prof. Frank Thielecke			
Admission Requirements				
Aumission nequirements	basic knowledge of:			
Recommended Previous Knowledge	mathematics     mechanics     thermo dynamics     electronics     fluid technology     control technology			
Educational Objectives	I. After taking part successfully, students have read	had the following learning results		
Professional Competence		ned the following learning results		
riolessional Competence	Students are able to			
Knowledge	<ul> <li>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.</li> <li>explain different configurations and designs and their origins</li> <li>explain atmospheric conditions for icing such as the functionality of anti-ice systems</li> </ul> Students are able to			
Skills	size primary flight control actuation systems     perform a controller design process for the flight control actuators.			
Personal Competence				
,	Students are able to:			
Social Competence				
Autonomy	derive requirements and perform approcessing a second complex issues and circumstances in a second complex issues and circumstances.		cesses for airc	raft systems from
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	165 Minutes			
Assignment for the Following Curricula	Aircraft Systems Engineering: Core qualification: International Management and Engineering: Spe Product Development, Materials and Production: Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Specialisati	cialisation II. Aviation Systems: Ele Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective ( ion Aircraft Systems Engineering: E	ent: Elective Compulsory Compulsory Elective Compu	ompulsory



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

Course L0740: Aircraft Sys	ourse 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		



0			
Courses			
Title Medical Imaging Systems (L081	Typ         Hrs/wk         CP           19)         Lecture         4         6		
Module Responsible	Dr. Michael Grass		
Admission Requirements	none		
Recommended Previous Knowledge	Inone		
Educational Objectives	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
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 fundame 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 imagenerated; Explain which image reconstruction methods are used to generate images;  Describe and explain the main clinical uses of the different systems.  Students are able to: Explain the physical processes of images and assign to the systems the basic mathematical or physical processes.		
Skills	<ul> <li>Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required;</li> <li>Calculate the parameters of imaging systems using the mathematical or physical equations;</li> <li>Determine the influence of different system components on the spatial and temporal resolution or imaging systems;</li> <li>Explain the importance of different imaging systems for a number of clinical applications;</li> </ul> Select a suitable imaging system for an application.		
Personal Competence			
Social Competence	none		
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		
Examination	Written exam		
Examination duration and			
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		



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				
	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: Mech	nanical Design Methodology			
Courses				
Title		Тур	Hrs/wk	СР
Mechanical Design Methodology	• • •	Lecture	3	4
Mechanical Design Methodology	y (L1524)	Recitation Section (small)	1	2
Module Responsible	Prof. Josef Schlattmann			
Admission Requirements	none			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Science-based working on product des	sign considering targeted application of spec	ific product de	sign techniques
Skills		or scientific preparation and formulation of co echniques following theoretical aspects.	mplex product	design problems
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Ti	me in Lecture 56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
•	Compulsory Mechatronics: Specialisation System E Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Biomedical Engineering: Specialisatio Product Development, Materials and P Product Development, Materials and P Product Development, Materials and P Theoretical Mechanical Engineering: S	neering: Specialisation II. Product Developmentalises of the Compulsory of Artificial Organs and Regenerative Medicing in Implants and Endoprostheses: Elective Commedical Technology and Control Theory: En Management and Business Administration production: Specialisation Product Developmentalises of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer Office of Computer of Course: Elective Office of Computer Office	ne: Elective Co mpulsory Elective Compu : Elective Com ent: Elective C e Compulsory Compulsory duction: Electiv	mpulsory Ilsory pulsory ompulsory

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



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



Module M1144: Manu	ufacturing with Polymers and	Composites	- From Molecule to	Part	
Courses					
Title			Тур	Hrs/wk	СР
Manufacturing with Polymers ar	nd Composites (L0511)		Lecture	2	3
From Molecule to Composites F	Part (L1516)		Project-/problem-based Learning	2	3
Module Responsible	Prof. Bodo Fiedler				
Admission Requirements	Non				
B d. d B d	Structure and Properties of Polymers				
Recommended Previous Knowledge	Structure and Properties of Composites				
Educational Objectives	After taking part successfully, students ha	ave reached the	following learning results		
Professional Competence					
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes polymers and composites and illustrate respective relationships. They are capable of describing and communicating relevant				
Skills	The students can transfer their fundamental knowledge on civil engineering to the process of solving practica problems. They identify and overcome typical problems during the realization of projects in the context of civil engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.				
Personal Competence					
Social Competence	Students are able to cooperate in small problems in the context of civil engineering groups in front of a qualified audiencengineering problem independently or in	ing. They are abl ce. Students ha	e to effectively present and ve the ability to develop	d explain their alternative	results alone or in
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 o corresponding solutions and concepts.				
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56			
Credit points	6				
Examination	Written elaboration				
Examination duration and scale	1,5 h				
Assignment for the Following Curricula	Product Development, Materials and Production, Specialisation Product Development, Flective Compilisory				

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



Course L1516: From Molecule to Composites Part				
Тур	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 M1145: Auto	mation and Simulation					
Courses						
Title		Тур	Hrs/wk	СР		
Automation and Simulation (L15): Automation and Simulation (L15):		Lecture Recitation Section (large)	3	3		
Module Responsible	Prof. Günter Ackermann					
Admission Requirements	none					
Recommended Previous Knowledge	BSc Mechanical Engineering or similar					
<b>Educational Objectives</b>	After taking part successfully, students have reach	ed the following learning results				
Professional Competence						
	Students can describe the structure an the function of process computers, the corresponding components, the dransfer via bus systems an programmable logic computers.					
Knowledge	They can describe the basich principle of a numer	ic simulation and the correspondi	ng parameters	S.		
Knowieuge	Thy can explain the usual method to simulate the o	dynamic behaviour of three-phase	e machines.			
	Students can describe and design simple controlle	ers using established methodes.				
	They are able to assess the basic characterisitcs of a given automation system and to evaluate, if it is adequate for a given plant.					
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 machines.	are able to applay established methods for the caclulation of the dynamical behaviour of three-phase les.				
Personal Competence						
-						
	Teamwork in small teams.  Students are able to identify the need of methocic analysises in the field of automation systems, to do these analysis in an adequate manner und to evaluate the results critically.			tems, to do these		
Autonomy						
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70				
Credit points						
Examination	Oral exam					
Examination duration and scale	Vorzugsweise in Dreier-Gruppen, etwa 1 Stunde					
Assignment for the Following Curricula	Energy Systems: Core qualification: Elective Compaircraft Systems Engineering: Specialisation Cabin Aircraft Systems Engineering: Specialisation Aircraft International Management and Engineering: Specialisation Management and Engineering: Specialisational Management and Engineering: Specialisational Management and Engineering: Specialisation Management and Engineering: Specialisation System Design: Electometrics: Specialisation Intelligent Systems and Product Development, Materials and Production: Specialisation Production: Specialisation Aircraft Systems and Product Development, Materials and Production: Specialisation Production: Specialisation Aircraft Systems and Production: Specialisation Aircraft Systems	n Systems: Elective Compulsory aff Systems: Elective Compulsory ecialisation II. Energy and Envirualisation II. Aviation Systems: Elective Compulsory tive Compulsory nd Robotics: Elective Compulsory Specialisation Product Development	ctive Compuls oment and Pro oment and Pro oment: Elective Co	sory oduction: Elective		



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

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



Module M1156: Syste	ems Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Systems Engineering (L1547)		Lecture	3	4
Systems Engineering (L1548)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements	None			
Recommended Previous Knowledge	Licetion Linguisconing			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence	<u>.                                    </u>	- J		
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 developmen process	t team and integrate themse	lves with their	role in the overall
Autonomy	Students are able to: • interact and communicate in a development team whice	ch has distributed tasks		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 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			



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

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



Module M1161: Turb	omachinery			
Courses				
Title Turbomachines (L1562) Turbomachines (L1563)		Typ Lecture Recitation Section (large)	Hrs/wk 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Franz Joos			
Admission Requirements	none			
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynar	nics, Heat Transfer		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students can      distinguish the physical phenomena     understand the different mathematic     calculate and evaluate turbomachine	modelling of turbomachinery,		
Skills	The students are able to - understand the physics of Turbomachinery - solve excersises self-consistent.	,		
Personal Competence				
Social Competence	The students are able to  • discuss in small groups and develop	an approach.		
Autonomy	The students are able to  develop a complex problem self-con analyse the results in a critical way, have an qualified exchange with oth	•		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems; Specialisation Marine Eng Product Development, Materials and Product Product Development, Materials and Product Product Development, Materials and Product	ineering: Elective Compulsory ction: Specialisation Product Developme ction: Specialisation Production: Elective	Compulsory	ompulsory



Course L1562: Turbomachines		
Тур	Lecture	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Franz Joos	
Language	DE	
Cycle	SoSe	
Content	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	<ul> <li>Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York</li> <li>Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York</li> <li>Menny: Strömungsmaschinen, Teubner., Stuttgart</li> </ul>	

Course L1563: Turbomachi	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: Phenomena and Methods in Materials Science				
Courses				
Title Experimental Methods for the C Phase equilibria and transforma	haracterization of Materials (L1580) tions (L1579)	<b>Typ</b> Lecture Lecture	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Patrick Huber			
Admission Requirements	none.			
Recommended Previous Knowledge	Fundamentals of Materials Science (I and II)			
Educational Objectives	After taking part successfully, students have re	ached 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 specialists and to develop ideas further.			
Autonomy	The students are able to      assess their own strengths and weaknesses.     define tasks independently.			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
_	International Management and Engineering: Compulsory Materials Science: Core qualification: Compuls Product Development, Materials and Production Product Development, Materials and Production Product Development, Materials and Production Theoretical Mechanical Engineering: Specialist	sory on: Specialisation Product De on: Specialisation Production: on: Specialisation Materials: C sation Materials Science: Elec	velopment: Elective Cor Elective Compulsory Compulsory ctive Compulsory	

Course L1580: Experimenta	al 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	<ul> <li>Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography)</li> <li>Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements)</li> <li>Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)</li> </ul>
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011).  William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).



Course L1579: Phase equil	Course L1579: Phase equilibria 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: Mech	nanical Properties			
Courses				
Title		Тур	Hrs/wk	СР
Mechanical Behaviour of Brittle		Lecture	2	3
Dislocation Theory of Plasticity	(L1662)	Lecture	2	3
Module Responsible	Dr. Erica Lilleodden			
Admission Requirements				
Recommended Previous Knowledge	Basics in Materials Science I/II			
<b>Educational Objectives</b>	After taking part successfully, student	s have reached the following learning re	esults	
Professional Competence				
Knowledge	Students can explain basic principles of crystallography, statics (free body diagrams, tractions) and thermodynamics (energy minimization, energy barriers, entropy)			
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations			
Personal Competence				-
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.			
	Students are able to			
	- assess their own strengths and wea	knesses		
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 lect needed	ures and notes to solve problems, and	to ask for help or o	clarifications when
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula				



Course L1661: Mechanical	Behaviour of Brittle Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider
Language	DE/EN
Cycle	SoSe
	Theoretical Strength Of a perfect crystalline material, theoretical critical shear stress  Real strength of brittle materials
	Energy release reate, stress intensity factor, fracture criterion  Scattering of strength of brittle materials  Defect distribution, strength distribution, Weibull distribution
	Heterogeneous materials I Internal stresses, micro cracks, weight function,  Heterogeneous materials II
	Toughening mechanisms: crack bridging, fibres  Heterogeneous materials III
Content	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
	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: Optir	mal and Robust Control			
Courses				
Title		Тур	Hrs/wk	CP
Optimal and Robust Control (L0		Lecture	2	3
Optimal and Robust Control (L0		Recitation Section (small)	2	3
Module Responsible	Prof. Herbert Werner			
Admission Requirements	Control Systems Theory and Design			
Recommended Previous Knowledge	Classical control (frequency response, re     State space methods     Linear algebra, singular value decompositions)	•		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	<ul> <li>Students can explain the significance of</li> <li>They can explain the duality between op</li> <li>They can explain how the H2 and H constraints.</li> <li>They can explain how an LQG design pr</li> <li>They can explain how model uncertain design</li> <li>They can explain how - based on the s performance for an uncertain plant.</li> <li>They understand how analysis and synmatrix inequalities.</li> </ul>	timal state feedback and optimal state feedback and optimal state feinfinity norms are used to represoblem can be formulated as special ty can be represented in a way that mall gain theorem - a robust control	te estimation. sent stability case of an H2 t lends itself to	and performance design problem. o robust controller antee stability and
Skills	<ul> <li>Students are capable of designing and tuning LQG controllers for multivariable plant models.</li> <li>They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it.</li> <li>They are capable of translating time and frequency domain specifications for control loops into constraints on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design.</li> <li>They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller.</li> <li>They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them.</li> <li>They can carry out all of the above using standard software tools (Matlab robust control toolbox).</li> </ul>			
Personal Competence				
•	Students can work in small groups on specific p	roblems to arrive at joint solutions.		
Autonomy	Students are able to find required information in and use it to solve given problems.		erature, softwa	re documentation)
Workload in Hours	Independent Study Time 124, Study Time in Lec	eture 56		
Credit points				
Examination				
Examination duration and scale	30 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence E Electrical Engineering: Specialisation Control at Energy Systems: Core qualification: Elective Co Aircraft Systems Engineering: Specialisation Air Computational Science and Engineering: Speci Mechatronics: Specialisation System Design: El Mechatronics: Specialisation System Design: El Mechatronics: Specialisation Intelligent Systems Biomedical Engineering: Specialisation Artificia Biomedical Engineering: Specialisation Implant Biomedical Engineering: Specialisation Medica Biomedical Engineering: Specialisation Medica Biomedical Engineering: Specialisation Manage Product Development, Materials and Production Product Development, Materials and Production Theoretical Mechanical Engineering: Core qual Theoretical Mechanical Engineering: Technical	and Power Systems: Elective Compulmpulsory craft Systems: Elective Compulsory alisation Systems Engineering and ective Compulsory s and Robotics: Elective Compulsory l Organs and Regenerative Medicin and Endoprostheses: Elective Cor Technology and Control Theory: E ement and Business Administration: :: Specialisation Product Developme :: Specialisation Production: Elective :: Specialisation Materials: Elective :: Specialisation Elective Compulsory	Robotics: Elective Cores estive Compulsory ective Compulsory ent: Elective Cores Compulsory Compulsory	mpulsory Isory pulsory



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

Course L0659: Optimal and	urse L0659: Optimal and Robust Control		
Тур	Recitation Section (small)		
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	See interlocking course		
Literature	See interlocking course		



Module M0563: Robo	otics			
Courses				
Title Robotics: Modelling and Control Robotics: Modelling and Control		Typ Lecture Recitation Section (small)	Hrs/wk 3 2	<b>CP</b> 3 3
Module Responsible	· · ·	,		
Admission Requirements				
	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	Students are able to describe fundamental properties robotics.	of robots and solution appro	aches for mu	ultiple problems in
Skills	Students are able to derive and solve equations of motion for various manipulators.  Students can generate trajectories in various coordinate systems.  Students can design linear and partially nonlinear controllers for robotic manipulators.			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small mixed groups.			
Autonomy	Students are able to recognize and improve knowledg With instructor assistance, students are able to evalua study.		I and define a	a further course of
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	)		
Credit points	6			
Examination	Written exam			
Examination duration and scale	1 1 2 0 min			
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Production Management: Specialisation Production Technology: 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 Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			



Course L0168: Robotics: M	odelling and Control
Тур	Lecture
Hrs/wk	3
СР	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: M	ourse 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: Fligh	t Physics			
Courses				
Title		Тур	Hrs/wk	СР
Aerodynamics and Flight Mecha	anics I (L0727)	Lecture	3	3
Flight Mechanics II (L0730)		Lecture	2	2
Flight Mechanics II (L0731)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
	Basic knowledge in:			
	Mathematics			
Recommended Previous	Mechanics			
Knowledge	Thermodynamics			
	Aviation			
Educational Objectives	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
Knowledge				
Skills	,			
Personal Competence				
Social Competence				
Autonomy	İ			
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	L120 Minutes (WS) + 90 Minutes (SS)			
Assignment for the Following Curricula	Product Dayalonmant Matarials and Production: Spacialisation Production: Flactive Compulsory			

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



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

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



Module M0815: Prod	uct Planning			
Courses				
Title		Тур	Hrs/wk	СР
Product Planning (L0851)		Project-/problem-based	3	3
rroddot ridining (20001)		Learning Project-/problem-based	Ü	Ü
Product Planning Seminar (L085	53)	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 reached 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 instruments			
Personal Competence				
Social Competence	Interact within a team     Raise awareness for globabl issues			
Autonomy	<ul> <li>Gain access to knowledge sources</li> <li>Interpret complex cases</li> <li>Develop presentation skills</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	Global Innovation Management: Core qualification: Com International Management and Engineering: Specialisati Mechanical Engineering and Management: Specialisatic Product Development, Materials and Production: Special Product Development, Materials and Production: Special Product Development, Materials and Production: Special Theoretical Mechanical Engineering: Specialisation Production Mechanical Engineering: Technical Completer	on I. Electives Management: on Management: Elective Col isation Product Developmen isation Production: Elective Col isation Materials: Elective Col duct Development and Produ	mpulsory it: Elective Cor Compulsory ompulsory oction: Elective	npulsory



Course L0851: Product Plan	nning
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
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

ourse L0853: Product Planning Seminar		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	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: Envi	ronmental Protection and Managen	nent		
Courses				
Title		Тур	Hrs/wk	СР
Integrated Pollution Control (L0	502)	Lecture	2	2
Health, Safety and Environment	tal Management (L0387)	Lecture	2	3
Health, Safety and Environment	tal Management (L0388)	Recitation Section (small)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Good knowledge of the relevant Environ</li> </ul>	mental Legislation	e, integrated so	lutions)
Educational Objectives	After taking part successfully, students have rea	ched 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 ecoefficiency 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 Led	cture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	190 min			
Assignment for the Following Curricula				



Course L0502: Integrated P	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	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>	
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)  Exercises can be downloaded from StudIP	

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



Madula M0967: Brad	uction Planning & Control	and Digital Enterprise		
Module Moor: Prod	uction Planning & Control a	and Digital Enterprise		
Courses				
Title		Тур	Hrs/wk	СР
The Digital Enterprise (L0932)		Lecture	2	2
Production Planning and Contro	l (L0929)	Lecture	2	2
Production Planning and Contro	l (L0930)	Recitation Section (small)	1	1
Exercise: The Digital Enterprise	e (L0933)	Recitation Section (small)	1	1
Module Responsible	Prof. Hermann Lödding			
Admission Requirements	None			
Recommended Previous Knowledge	Leundamentals of Production and Oua	ality Management		
<b>Educational Objectives</b>	After taking part successfully, student	ts have reached the following learning results		
Professional Competence				
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.			
Skills	Skills Students are capable of choosing and applying models and methods from the module to industrial problems.		I problems.	
Personal Competence				
Social Competence	Students can develop joint solutions in mixed teams and present them to others.			
Autonomy	ny -			
Workload in Hours	Workload in Hours Independent Study Time 96, Study Time in Lecture 84			
Credit points	Credit points 6			
Examination	on Written exam			
Examination duration and scale	180 Minuten			
	International Management and Engineering: Specialisation II. Product Development and Production: Electory  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 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  Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory  Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		y mpulsory Ilsory ompulsory	

Course L0932: The Digital E	ourse L0932: The Digital 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	Modelling of business processes and data, simulation Knowledge and competence management Process management (MRP, workflow management) Computer Aided Planning (CAP) Virtual Reality (VR) and Augmented Reality (AR) Computer Aided Quality Management (CAQ) E-Collaboration		
Literature	Scheer, AW.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006		



Course L0929: Production F	ourse 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	<ul> <li>Vorlesungsskript</li> <li>Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008</li> <li>Nyhuis, P.; Wiendahl, HP.: Logistische Kennlinien, Springer 2002</li> </ul>		

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

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



Module M0962: Sustainability and Risk Management				
Courses				
<b>Title</b> Safety, Reliability and Risk Asse Environment and Sustainability	•	<b>Typ</b> Seminar Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have	reached the following learning re	sults	
Professional Competence				
Knowledge Skills	Students are able to describe single technias well as environmental and sustainable e  basics in safety and reliability of tech safety and reliability analysis metho risk assessment  Production and usage of bio-char energy production and supply sustainable product design  Students are able apply interdisciplinary sy They can evaluate the effort and costs for present as well as well as the single technical and supply to the sustainable product design	ingineering, in detail:  nnical facilities  ds  vstem-oriented methods for risk as	ssessment and sustai	nability reporting.
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the su Furthermore, they can define targets for no sustainability concepts accordance with the	ew application or research-orient	ed duties in for risk i	·
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minutes in	n groups)		
•	Civil Engineering: Core qualification: Comp International Management and Engineering Product Development, Materials and Produ Product Development, Materials and Produ Product Development, Materials and Produ Water and Environmental Engineering: Cor	g: Specialisation II. Civil Engineerin ction: Specialisation Product Deve ction: Specialisation Production: E ction: Specialisation Materials: Ele	elopment: Elective Co Elective Compulsory	•

Course L1145: Safety, Relia	ability and Risk Assessment
Тур	Seminar
Hrs/wk	2
СР	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	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>



Course L0319: Environment and Sustainability		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Kerstin Kuchta	
Language	EN	
Cycle	WiSe	
	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.	



Madula M1004: Math	ada at Interveted Dvaduat Davidan			
wodule wituz4: weth	ods of Integrated Product Develop	ment		
Caumaga				
Courses				
Title	. 11. (1. 405.1)	Тур	Hrs/wk	СР
Integrated Product Developmen	it II (L1254)	Lecture Project-/problem-based	3	3
Integrated Product Developmen	it II (L1255)	Learning	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements				
	Basic knowledge of Integrated product develop	ment and applying CAF systems		
Knowledge		mont and applying on a systems		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
	After passing the module students are able to:			
	<ul> <li>explain technical terms of design method</li> </ul>	dology		
Knowledge	describe essential elements of construct			
	<ul> <li>describe current problems and the curre</li> </ul>	nt state of research of integrated pr	oduct developr	nent.
	After passing the module students are able to:			
	· -			
Chille	select and apply proper construction means beyondary conditions.	ethods for non-standardized solution	ons of problems	s as well as adapt
Skills	new boundary conditions, <ul><li>solve product development problems wi</li></ul>	th the assistance of a workshop has	sed approach	
	choose and execute appropriate modera		ou apploadin,	
Personal Competence	After a considerable and other and o			
	After passing the module students are able to:			
Social Competence	<ul> <li>prepare and lead team meetings and me</li> </ul>	oderation processes,		
	work in teams on complex tasks,	diverse ideas		
	<ul> <li>represent problems and solutions and a</li> </ul>	dvance ideas.		
	After passing the module students are able to:			
Autonomy	<ul> <li>give a structured feedback and accept a</li> </ul>	critical feedback		
riaterioni,	implement the accepted feedback auton			
	Independent Study Time 110, Study Time in Lec	cture 70		
Credit points				
Examination	Oral exam			
Examination duration and scale	30 Minuten			
555.0	Aircraft Systems Engineering: Specialisation Ca	abin Systems: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Air		Compulsory	
	International Management and Engineering:	Specialisation II. Product Develo	pment and Pr	oduction: Elective
A1	Compulsory	leaff a Committee		
	Mechatronics: Specialisation System Design: E		ont: Compular	n,
Following Curricula	Product Development, Materials and Production Product Development, Materials and Production	·		ıy
	Product Development, Materials and Production			
	Theoretical Mechanical Engineering: Technical	•		
	Theoretical Mechanical Engineering: Specialisa			e Compulsory



se L1254: Integrated F	Product Development II
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
	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 marks transite.
	Development management for mechatronics,     Technical Supply Chain Management.
	Technical Supply Shall Mahagement.
	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.
	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,  Participal Michigan Bull. 2007.  Participal Michigan Bull. 2007.  Participal Michigan Bull. 2007.
Literature	Berater und Trainer, Weinheim, Beltz 2007.  Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006.
	Path, G., Beltz, W.: Konstruktionsterile, Berlin, Springer 2006.      Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000.
	,gs., 28, 28gs., 28, 28gs.

- 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	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M1002: Prod	luction and Logistics Managemen	nt		
Courses				
<b>Title</b> Operative Production and Logis	stics Management (L1198)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Strategic Production and Logisti	ics Management (L1089)	Project-/problem-based Learning	3	4
Module Responsible	Prof. Wolfgang Kersten			
Admission Requirements	None			
	Introduction to Business and Management			
Recommended Previous Knowledge	The previous knowledge, that is necessary learning. Log-in and additional information wi			accessable via e-
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students will be able  to differentiate between strategic and operational production and logistics management,  to describe the areas of production and logistics management,  understand the difference between traditional and new concepts of production planning and control,  to describe and explain the actual challenges of production and logistics management, esp. in an international context.			
Skills	Based on the acquired knowledge students are capable of  - Applying methods of production and logistics management in an international context,  - Selecting sufficient methods of production and logistics management to solve practical problems,  - Selecting appropriate methods of production and logistics management also for non-standardized problems,  - Making a holistic assessment of areas of decision in production and logistics management and relevant influence factors.			
Personal Competence				
Social Competence	After completion of the module students can  - lead discussions and team sessions,  - arrive at work results in groups and document them,  - develop joint solutions in mixed teams and present them to others,  - present solutions to specialists and develop ideas further.  After completion of the module students can  - assess possible consequences of their professional activity,			
Autonomy	- define tasks independently, acquire the requisite knowledge and use suitable means of implementation, - define and carry out research tasks bearing in mind possible societal consequences.			
Workload in Hours	I Independent Study Time 110, Study Time in L	ecture 70		
Credit points				
•	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	I Product Development Materials and Producti	alification: Compulsory ion: Specialisation Product Developm ion: Specialisation Production: Electiv	e Compulsory	ompulsory



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



ourse L1089: Strategic Pr	oduction and Logistics Management		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР			
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Wolfgang Kersten, Dr. Meike Schröder		
Language			
Cycle	Identification of the scope of production, operations and logistics management     Understanding of actual challenges concerning production and logistics strategy     Understanding operations as a competitive weapon     Identification and design of the main elements of an operations strategy (level of vertical integration technology strategy, location strategy, capacity strategy) of a company     Evaluation of operation strategies of different companies and industrial sectors     In depth discussion of methods and concepts of production and logistics management     In depth discussion of lean management: Main goals and measures of lean management and lear production concepts, impact of lean management on production strategy     Presentation and discussion of current research topics in the field of production and logistics management     Integration of Problem-Based-Learning sessions in order to enhance teamworking and problem solving skills as well as presentation skills		
Literature	Corsten, H. /Gössinger, R. (2009): Produktionswirtschaft — Einführung in das industrielle Produktionsmanagement 12. Auflage, München: Oldenbourg.  Dyckhoff, H. /Spengler, T. (2007): Produktionswirtschaft — eine Einführung für Wirtschaftsingenieure, 2. Auflage Berlin Heidelberg [u.a.]: Springer.  Heizer, J./Render, B (2011): Operations Management, 10. Auflage, Upper Saddle River.  Henderson, S./ Illidge, R./Machardy, P. (1994): Management for engineers, Oxford: Butterworth-Heinemann.  Porter, M. E. (2008): Wettbewerbsstrategie — Methoden zur Analyse von Branchen und Konkurrenten, 11. Auflage Frankfurt/Main [u.a.]: Campus-Verlag.  Slack, N./ Lewis, M.(2002): Operations Strategy, Harlow u.a.  Swink, M./ Melnyk, S./ Cooper, M./ Hartley, J.(2011): Managing Operations across the Supply Chain, New York u.a.  Wortmann, J. C. (1992): Production management systems for one-of-a-kind products, Computers in Industry 19, S 79-88  Womack, J./ Jones, D./ Roos, D. (1990): The Machine that changed the world; New York.  Zahn, E. /Schmid, U. (1996): Grundlagen und operatives Produktionsmanagement, Stuttgart: Lucius & Lucius Zäpfel, G.(2000): Produktionswirtschaft: Strategisches Produktions-Management, 2. Aufl., München u.a.		



Module M1155: Aircr	raft Cabin Systems			
Courses				
Title		Тур	Hrs/wk	СР
Aircraft Cabin Systems (L1545)		Lecture	3	4
Aircraft Cabin Systems (L1546)		Recitation Section (large)	1	2
Module Responsible	Prof. Ralf God			
Admission Requirements				
Recommended Previous Knowledge	Basic knowledge in:  • Mathematics  • Mechanics  • Thermodynamics  • Electrical Engineering  • Control Systems			
Educational Objectives	After taking part successfully, students have reached the	e 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 discuss their ideas with experts			
Autonomy	Students are able to: • Reflect the contents of lectures and expert presentatio	ns self-dependent		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 120 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 Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			



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

Course L1546: Aircraft Cabin Systems		
Тур	Recitation Section (large)	
Hrs/wk	1	
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 M1025: Fluid	ics			
Courses				
Title		Тур	Hrs/wk	CP
Fluidics (L1256)		Lecture	2	3
Fluidics (L1371)		Project-/problem-based Learning	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, ela and engineering design	astostatics, hydrostatics, kinematic	es and kinetics	), fluid mechanics,
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
	After passing the module students are able to			
Knowledge	<ul> <li>explain structures and functionalities of hydrostatic, pneumatic, and hydrodynamic components,</li> <li>explain the interaction of hydraulic components in hydraulic systems,</li> <li>explain open and closed loop control of hydraulic systems,</li> <li>describe functioning and applications of hydrodynamic torque converters, brakes and clutches as well as centrifugal pumps and aggregates in plant technology</li> </ul>			
Skills	After passing the module students are able to  • analyse and assess hydraulic and pneumatic components and systems,  • design and dimension hydraulic systems for mechanical applications,  • perform numerical simulations of hydraulic systems based on abstract problem definitions,  • select and adapt pump characteristic curves for hydraulic systems  • dimension hydrodynamic torque converters and brakes for mechanical aggregates.			
Personal Competence				
Social Competence	After passing the module students are able to  discuss and present functional context in good organise teamwork autonomously.	roups,		
	After passing the module students are able to			
Autonomy	obtain necessary knowledge for the simula	ation.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
•	Written exam			
Examination duration and				
•	International Management and Engineering: Specific International Management and Engineering: Specific International Management and Engineering: Specific International Management and Engineering: Specialisation of the Product Development, Materials and Production: Theoretical Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Technical Communications of the Product Mechanical Engineering: Technical Communications of the Product Office International Communication International Communication International Communication International Communication International Communication International Communication International Communication International Communication International Communication Internation International Communication International Communication International Communication Internation International Communication International Communication Internation Internation Internation Internatio	pecialisation II. Product Develop Specialisation Product Developme Specialisation Production: Elective Specialisation Materials: Elective on Product Development and Product D	oment and Prent: Compulso e Compulsory Compulsory duction: Electiv	oduction: Elective



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

Skript zur Vorlesung



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

Course L1257: Fluidics	urse 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: Laser systems and methods of manufacturing design and analysis				
Courses				
Title		Тур	Hrs/wk	CP
Laser Systems and Process Te	· ,	Lecture	2	3
Methods for Analysing Production		Lecture	2	3
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning i	results	
Professional Competence				
Knowledge				
Skills				
Personal Competence	,			
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Product Development Materials and Production: Specialisation Materials: Elective Compulsory			

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



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



Module M1174: Auto	mation Technology and Systems			
Courses				
Title		Тур	Hrs/wk	СР
Handling and Assembly System	ns (L1591)	Lecture	2	2
Handling and Assembly System	as (L1738)	Recitation Section (small)	1	1
Automation Technology (L1590)		Lecture	2	2
Automation Technology (L1739)		Recitation Section (small)	1	1
<u>-</u>	Prof. Thorsten Schüppstuhl			
Admission Requirements				
Knowledge	without major course assessment			
	After taking part successfully, students have react	ned the following learning results		
Professional Competence				
,	Students			
Knowledge	know the characteristic components of interaction     know methods for a systematical analysis     have special competences in industrial ro	of automation tasks and are able to		rstanding of their
Skills	analyze complex Automation tasks     develop application based concepts and design subsystems and integrate into one investigate and evaluate safety of machine create simple programs for robots and production.	system ery grammable logic controllers		
Personal Competence				
Social Competence	Students are able to  - find solutions for automation and handling tasks  - develop solutions in a production environment	- '	al level and re	oresent decisions.
Autonomy	Students are able to  analyze automation tasks independently generate programs for robots and program develop solutions for practice oriented tas design safety concepts for automation app assess consequences of their professions	ks of automation independently blications	у	
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Product Development, Materials and Production: Product Development, Materials and Production: Product Development, Materials and Production: Theoretical Mechanical Engineering: Technical C Theoretical Mechanical Engineering: Specialisati	Specialisation Production: Compul Specialisation Materials: Elective Complementary Course: Elective Co	sory Compulsory ompulsory	, ,



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

Course 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 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	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	



Module M0719: Biom	naterials and Regenerative Medicine	)			
Courses					
<b>Title</b> Biomaterials (L0593) Regenerative Medicine (L0347)		<b>Typ</b> Lecture Seminar	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge of surgical techniques and of it	mplants and endoprotheses a	are recommended.		
Educational Objectives	After taking part successfully, students have read	ched the following learning re	sults		
Professional Competence	The students can describe the material characteristics of materials used in medical engineering, including the advantages and disadvantages.				
Knowledge	The students can name the polymers, metals and synthetic materials used in humans.  The student has a basic understanding on issues of regenerative medicine.				
Skills	The students can explain the advantages and disadvantages of the materials used in medical engineering.  The student can explain and describe the basic principles of cell use for regenerative medical applications.  The student can use literature databases for accumulation and presentation of relevant up-to-date data.			olications.	
Personal Competence					
Social Competence	The student can lead discussions and participate in them, representing work results.				
Autonomy	The student has the ability to acquire knowledge	e independently and transfer t	he acquired knowled	dge to new issues	
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56			
Credit points	6				
Examination					
Examination duration and scale	90 minutes, between 20 and 50 questions				
Assignment for the Following Curricula	Product Development, Materials and Production	: Specialisation Materials: Ele	ective Compulsory		



Course L0593: Biomaterials	s
	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	
Cycle	
	Topics to be covered include:
	Introduction (Importance, nomenclature, relations)
	Biological materials
	2.1 Basics (components, testing methods)
	2.2 Bone (composition, development, properties, influencing factors)
	2.3 Cartilage (composition, development, structure, properties, influencing factors)
	2.4 Fluids (blood, synovial fluid)
	3 Biological structures
	3.1 Menisci of the knee joint
	3.2 Intervertebral discs
	3.3 Teeth
	3.4 Ligaments
	3.5 Tendons
Content	3.6 Skin
	3.7 Nervs
	3.8 Muscles
	4. Replacement materials
	4.1 Basics (history, requirements, norms)
	4.2 Steel (alloys, properties, reaction of the body)
	4.3 Titan (alloys, properties, reaction of the body)
	4.4 Ceramics and glas (properties, reaction of the body)
	4.5 Plastics (properties of PMMA, HDPE, PET, reaction of the body)
	4.6 Natural replacement materials
	Knowledge of composition, structure, properties, function and changes/adaptations of biological and technical materials (which are used for replacements in-vivo). Acquisition of basics for theses work in the area of biomechanics.
	Hastings G and Ducheyne P.: Natural and living biomaterials. Boca Raton: CRC Press, 1984.
	Williams D.: Definitions in biomaterials. Oxford: Elsevier, 1987.
	Hastings G.: Mechanical properties of biomaterials: proceedings held at Keele University, September 1978. New York: Wiley, 1998.
Literature	Black J.: Orthopaedic biomaterials in research and practice. New York: Churchill Livingstone, 1988.
	Park J. Biomaterials: an introduction. New York: Plenum Press, 1980.
	Wintermantel, E. und Ha, SW: Biokompatible Werkstoffe und Bauweisen. Berlin, Springer, 1996.



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



Module M1342: Poly	mers				
Courses					
Title		Тур	Hrs/wk	СР	
Structure and Properties of Poly Processing and design with poly		Lecture Lecture	2	3	
	<u> </u>	Locture		0	
Module Responsible Admission Requirements					
Recommended Previous  Knowledge	Basics: chemistry / physics / material science				
Educational Objectives		ched the following learning res	sults		
Professional Competence					
	Students can use the knowledge of plastics a	and define the necessary tes	sting and analysis.		
Knowledge	They can explain the complex relationships structure-property relationship and				
	the interactions of chemical structure of the polymers, including to explain neighboring contexts (e.g. sustainability, environmental protection).  Students are capable of				
Skills	- using standardized calculation methods in a given context to mechanical properties (modulus, strength) to				
	- For mechanical recycling problems selecting appropriate solutions and sizing example Stiffness, corrosion resistance.				
Personal Competence					
	Students can,				
Social Competence	- arrive at work results in groups and docume	ent them.			
	- 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.				
	- assess possible consequences of their prof	essional activity.			
	Independent Study Time 124, Study Time in Lec	ture 56			
Credit points					
	Written exam				
Examination duration and scale	I 18() min				
Assignment for the Following Curricula	I Blomedical Engineering, Specialisation Medical	s and Endoprostheses: Comp Organs and Regenerative Me ement and Business Administr Technology and Control The Specialisation Production: El Specialisation Materials: Ele Specialisation Product Deve	ulsory edicine: Elective Con ation: Elective Compory: Elective Compul lective Compulsory ctive Compulsory lopment: Elective Co	oulsory sory	



Course L0389: Structure an	d 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
l ite wat wa	Chronoteirs Dolumos Workstoffe Cod Honory Voylog
Literature	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: Te Regulations)	chnical Complementary Course for PEPMS (according to Subject Specif
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



## **Supplement Modules Core Studies**

Module M0599: Integ	rated Product Development and Light	weight Design		
Courses				
Title		Тур	Hrs/wk	СР
CAE-Team Project (L0271)		Project-/problem-based Learning	2	2
Development of Lightweight Des Integrated Product Developmen	-	Lecture Lecture	2	2
	· · · · · · · · · · · · · · · · · · ·	20010		
Module Responsible Admission Requirements				
- Adminosion requirements	Advanced Knowledge about engineering design:			
	Fundamentals of Mechanical Engineering Design			
Recommended Previous				
Knowledge	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
	After completing the module, students are capable of	f:		
Knowledge	explaining the functional principle of 3D-CAI     describing the interaction of the different CAI	-		s
Skills	After completing the module, students are able to:   • evaluate different CAD- and PDM-Systems with regards to the desired requirements such as classification schemes and product structuring  • design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload			
Personal Competence  Social Competence	After completing the module, students are able to:  • To develop a project plan and allocate work appropriate work packages, in the framework of group			
	Students are capable of:			İ
Autonomy	independently adapt to a CAE-Tool and com	plete a given practical task with	n it	
Workload in Hours	I	34		
Credit points	1			
Examination	Written exam			
Examination duration and scale	190			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory			



Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory

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

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



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



Module M0726: Prod	uction Technology			
Courses				
<b>Title</b> Fundamentals of Machine Tools Forming and Cutting Technolog Forming and Cutting Technolog	y (L0613)	Typ Lecture Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 2	<b>CP</b> 3 2
	· · · · · · · · · · · · · · · · · · ·	i toolidaton eestien (ia. ge)	•	
Admission Requirements	Prof. Wolfgang Hintze			
Admission nequirements	without major course assessment			
Recommended Previous Knowledge	internship recommended	echanics and electrical engineering		
Educational Objectives	After taking part successfully, students I	have reached the following learning results	<b>;</b>	
Professional Competence		9 9		
Knowledge	Students are able to  explain the basics of chip formation and mechanisms and models of machining.  explain methods and parameters for design and analysis of metal forming, machining processes and tools.  explain technical concepts of machine tool building and give an overview on trends in the machine tool industry.  explain types, constructions and functions of CNC-machines and give an overview on multi-machine systems.  explain equipment components.			
Skills	Students are able to  • select tool geometry, cutting materials, process parameters and appropriate measuring technique in accordance with the requirements.  • estimate occurring forces and temperatures during chip formation.  • select appropriate machine tools for machining and create NC programs for turning and milling.  • assess the quality of a machine tools and to detect weak points.			
Personal Competence				
Social Competence		tion environment with qualified personnel	at technical le	evel and represent
Autonomy	Students are able to  interpret independently cutting processes. create independently NC programs. select independently machine tools by reference to appropriate requirements. assess own strengths and weaknesses in general. assess their learning progress and define gaps to be improved. assess possible consequences of their actions.			
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	I 180 min			
Assignment for the Following Curricula	Development and Production: Compuls General Engineering Science (Germa Product Development and Production: General Engineering Science (Eng Development and Production: Compuls General Engineering Science (Englis Product Development and Production: Mechanical Engineering: Specialisation	an program, 7 semester): Specialisation Compulsory lish program): Specialisation Mechanic sory sh program, 7 semester): Specialisation	Mechanical E al Engineering Mechanical E pmpulsory	ngineering, Focus g, Focus Product ngineering, Focus

Compulsory



Course L0689: Fundamenta	als of Machine Tools
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Thorsten Schüppstuhl
Language	
Cycle	WiSe
	Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
Content	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
Literature	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Demin (u.a.). Springer, 2003
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
	ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006



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

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



Module M1009: Mate	rial Science Laboratory			
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Courses				
Title		Тур	Hrs/wk	CP
Companion Lecture for Material Material Science Laboratory (L		Lecture Practical Course	2 4	2 4
Module Responsible		Tractical Course	· .	<u> </u>
Admission Requirements				
Recommended Previous  Knowledge	none			
Educational Objectives	After taking part successfully, students have reach	ed the following learning resu	ılts	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on material sciences to the process of solving practica problems. They identify and overcome typical problems during the realization of experiments in the context of material sciences.			
Personal Competence				
	Students are able to cooperate in small groups in order to conduct experiments in the context of materials science. They are able to effectively present and explain their results alone or in groups in front of a qualified audience.			
Autonomy	Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor.		-	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	1,5 h written Exam (50%) covering the lesson			
•	General Engineering Science (German programengineering Sciences: Compulsory General Engineering Science (German programevelopment and Production: Compulsory General Engineering Science (German programeterials in Engineering Sciences: Compulsory General Engineering Sciences: Compulsory General Engineering Science (English programengineering Sciences: Compulsory General Engineering Science (English programeral Engineering Science (English programevelopment and Production: Compulsory General Engineering Sciences: Compulsory Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Product December 1 Mechanical Engineering: Specialisation Materials Product Development, Materials and Production	am): Specialisation Mechan, 7 semester): Specialisation in: Specialisation Mechanican): Specialisation Mechanican): Specialisation Mechanican, 7 semester): Specialisation in: Specialisation in: Engineering Sciences: Control in: Specialisation in: Engineering Sciences: Control in: Specialisation in: Engineering Sciences: Control in: Specialisation in: Sp	nical Engineering on Mechanical Er al Engineering, Foundation nical Engineering on Mechanical Er Compulsory mpulsory	r, Focus Product ngineering, Focus ocus Materials in , Focus Product ngineering, Focus



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

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



## **Thesis**

Module M-002: Maste	er Thesis	
Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Professoren der TUHH	
	According to General Regulations §24 (1):	
Admission Requirements	At least 78 credit points have to be achieved in study programme. The examinations board decides of exceptions.	
Recommended Previous Knowledge		
-	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	<ul> <li>The students can use specialized knowledge (facts, theories, and methods) of their subject competently of specialized issues.</li> <li>The students can explain in depth the relevant approaches and terminologies in one or more areas of the subject, describing current developments and taking up a critical position on them.</li> <li>The students can place a research task in their subject area in its context and describe and critically asse the state of research.</li> </ul>	
Skills	<ul> <li>To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.</li> <li>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.</li> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>	
Personal Competence		
Social Competence	<ul> <li>Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> <li>Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their own assessments and viewpoints convincingly.</li> </ul>	
Autonomy	<ul> <li>Students are able:</li> <li>To structure a project of their own in work packages and to work them off accordingly.</li> <li>To work their way in depth into a largely unknown subject and to access the information required for them to do so.</li> <li>To apply the techniques of scientific work comprehensively in research of their own.</li> </ul>	
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0	
Credit points		
Examination	Thesis	
Examination duration and scale	see FSPO	
	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 Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory International Production Management: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory	



Materials Science: Thesis: Compulsory

Mechanical Engineering and Management: Thesis: Compulsory

Mechatronics: Thesis: Compulsory

Biomedical Engineering: Thesis: Compulsory

Microelectronics and Microsystems: Thesis: Compulsory

Product Development, Materials and Production: Thesis: Compulsory

Renewable Energies: Thesis: Compulsory

Naval Architecture and Ocean Engineering: Thesis: Compulsory

Ship and Offshore Technology: Thesis: Compulsory Theoretical Mechanical Engineering: Thesis: Compulsory

Process Engineering: Thesis: Compulsory
Water and Environmental Engineering: Thesis: Compulsory